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Operation of Mining Drills. THE elaborate and well illustrated paper on this subject read by Mr. Marvin before the American Institute of Electrical Engineers at its Chicago meeting in June is printed in full elsewhere in our columns. Those of our readers who are interested in the construction and operation of the electric drill will find Mr. Marvin's paper full of plain and very practical information. He takes up in succession the various types of the electric drill, and indicates very clearly the requirements of each, and its advantages and disadvantages for various classes of work. The field for the display of the electrical engineer's ingenuity in devising mining apparatus of practical value is constantly broadening, and no one who goes over the ground carefully can fail to see that this is one of the great electrical industries of the very near future.

Electrical Work in Philadelphia. THE annual report of Chief Walker of the Electrical Bureau of Philadelphia for 1891, just issued, contains some interesting information of electrical work in that city. The citizens of Philadelphia are fortunate in having such a well organized electrical department, for the report, a model of its kind, gives evidence of careful and methodical work. We know of no other city which has such a complete and thorough report of the work of this kind done during the year. The report shows that there were at the end of 1891 1,871 arc lights in the city; 12,982 poles, of which 5,530 were owned by the city; 3,556 miles of telegraph and telephone wires and 652 miles of electric light wires. In addition to this the city has 887 miles of overhead wires. There are also 1,474 miles of underground wires, 136 miles being owned by the city. The number of messages transmitted over the police wires during the year was 324,202.

A Convenient Efficiency Diagram. A DIAGRAM given elsewhere in our columns will prove of considerable service to those whose work calls for the frequent calculation of the efficiency of dynamos, motors, transformers or other electrical apparatus. No matter how simple the formula may be for finding certain unknown quantities, a diagram from which the same results may be obtained without calculation is rightly regarded by the electrical engineer as a more convenient and comprehensive, as well as a more accurate, method of arriving at the desired result. By the use of this diagram, which we publish this week, any one may determine by inspection any one of three things: (1) The efficiency of a dynamo, motor or other apparatus provided the output and input are given; (2) the output when the input and efficiency are given; and (3) the input when the output and efficiency are known. Although these are comparatively simple problems they are just the sort that are continually proposed by that large class of electrical students to whom the solution of an equation, however simple, is regarded as a problem in "higher mathematics" to be grappled with only by the technical graduate or the college professor.

Phonographic Study of Speech. A VERY interesting account of what has already been accomplished by Mr. R. L. Garner in the study of speech by the aid of the phonograph appeared in the August number of the *Forum*. As it is now pretty generally known, Mr. Garner has made a special study of the speech of men and monkeys by the aid of the phonograph. In the article referred to he points out a number of ways in which additional information of scientific value can be obtained by further experimental work along this line, indicating his intention as soon as he returns from his African trip of pursuing his studies still further in the direction that he has mapped out. Some very interesting results were obtained by recording upon the phonograph cylinder the speech and musical tones of different persons and then reproducing these while the phonograph cylinder was revolving at a very much higher rate of speed, or at a very much lower rate than that at which the record was made. Although Mr. Garner does not regard the phonograph in its present condition as by any means a perfect instrument, he considers it of very great value and assistance in carrying out a scientific study of human speech, as well as in analyzing the various sounds made by different animals, such as birds and monkeys.

The British Association. OUR cable dispatch this week records the progress of a highly successful meeting of the British Association, in session at Edinburgh as we go to press. The British Association is rightly looked upon at the present time as the most celebrated, as it is the oldest summer gathering of scientists who come together, not only from Great Britain, but from all parts of the world, to discuss questions of theoretical and practical importance. The present session seems to be especially well attended by representatives from the United States and the Continent, and to be especially fortunate in the large number and variety of the papers presented, although very few of these were announced in advance. The discussion on electrical standards, and that on the establishment of a national physical laboratory, promise to be of the greatest value as subjects of international importance; while the presentation of the results of Prof. Ewing's researches on the automatic tracing of hysteresis curves is looked forward to with the greatest interest. The character of the apparatus with which Prof. Ewing accomplishes these results is described by our correspondent in the cable dispatch as fully as was possible, considering the difficulty of obtaining information in advance of the reading of the paper. It is certainly of interest to know that Prof. Ewing has carried out his experiments to such an extent that his results are not confined to the laboratory, where the greatest precision may be had, for it is announced that he has adapted the method to apparatus suitable for the workshop, where, as a rule, only rough methods of measurement are possible.

The "Study" of Electricity. THE rapid growth of the industrial applications of electricity has placed the study of electrotechnics on a footing with the older branches of engineering, if, indeed, it has not already outstripped them. Statistics show that the number of students who choose the electrical studies at our larger universities and technical schools is yearly increasing. At Cornell University, for instance, the number has increased from 28 in 1884 to 250 in 1892; and this is only a specimen of the continued growth in other institutions. Evidence is not wanting that the coming year will be no less a prosperous one in this respect for the universities than preceding ones. We receive almost daily communications from men of all ages and engaged in a great variety of occupations asking for advice and direction in the choice of a method of securing an electrical education or for assistance in the selection of an institution at which the study of electrical engineering may be pursued to the greatest advantage. Of course this is a question to which a definite answer can only be given for each individual case, as the circumstances of the student, the means at his command, his age, his previous training, either in the school or the shop, must be considered. There is undoubtedly a tendency among the younger men who have been trained in the shop to take a partial or complete course in electrical engineering at some reputable university whenever circumstances will permit of it. We cannot do better in this connection than recommend the perusal of the remarks in our editorial columns on this subject in THE ELECTRICAL WORLD of Aug. 8, 1891.

Foreigners and the World's Fair. "RATHER no English section at all than a poor one," says the London *Electrical Review* upon the question of foreign exhibits at the World's Fair. This is undoubtedly the most patriotic as it is the most sensible view to take of the situation: but, although no very great amount of work has yet been done in the way of preparing for an elaborate exhibit, it is not at all probable that the attempt to display English apparatus will be abandoned entirely. Foreign manufacturers are just beginning to get interested in the fair and its opportunities to advertise their goods, not only to Americans, but to visitors from all parts of the world, and considered in this light the McKinley tariff, which has been so often referred to by our foreign contemporaries as the chief obstacle to the success of the foreign section of the Fair, should have little influence with a manufacturer in deciding whether or not he will be commercially repaid for making an elaborate exhibit. A great many foreigners will visit the Fair for the purpose of comparing the construction, the general appearance, the operation and the cost of English, French, German and American machinery and apparatus—not to mention that from other countries—and they will expect to find a suitable and comprehensive display from each of these countries. Although the time to prepare for the exhibition is now short it is probable that foreign firms will make a creditable display of their best apparatus. Mr. Preece is agitating the subject in England, and will doubtless succeed in arousing considerable enthusiasm. In connection with the list of English firms already announced as preparing to take part in the Exhibition, we give in another column an outline of the preliminary steps which French manufacturers are taking in their efforts to make as good a display as their rivals from any other nation.

An Automatic Telephone Exchange. A VERY ingenious piece of apparatus intended as a substitute for the telephone girl is described elsewhere in our columns. It is not a new type of telephone, but merely an adjunct to the ordinary Bell transmitter and receiver by which any subscriber can place himself in connection with any other subscriber with whom he wishes to converse merely by the operation of a set of simple keys placed upon the telephone box at the subscriber's end of the line. It is not an easy matter to tell just how extended an application apparatus of this kind may find, but there are doubtless many places in which its application to existing telephone plants would prove economical. This is especially true of such places as large factories where the heads of different departments, who must communicate frequently with each other, are located in detached buildings, and also in small towns where the number of subscribers does not exceed a few hundred. Although there is nothing in the construction of the instrument itself to prevent its application to exchanges having several thousand subscribers, the multiplicity of contacts in such cases would doubtless be considered an objection to its use, although this could probably be satisfactorily arranged. Another point which might be raised against it would be the difficulty or complication made necessary in arranging to connect with the various lines of the long distance telephone service. It is of interest in this connection to notice that according to the statistics of the telephone industry, recently published by Mr. Allen R. Foote, for the decade preceding 1890, that the average number of telephone subscribers per exchange in the United States was 183, while the average number of employés per exchange was seven, or, in other words, the average number of subscribers per employe was 26. The average daily calls per subscriber are shown by the same statistics to vary from 4.8 in exchanges of 100 or less subscribers to 8.9 in exchanges of 1,500 subscribers or over. Taking seven as the average in all the exchanges, this would indicate that one employé is necessary for every 175 calls per day. The Strowger apparatus will doubtless find a wide application in many places where the present high telephone tariffs have prevented the introduction of any telephone system, since we may look for the establishment of exchanges within the next two years in towns that average a very much smaller population than even the smallest towns where telephone exchanges are now in use.

The Edinburgh Meeting of the British Association.

(By Cable from our Special Correspondent.)

EDINBURGH, Aug. 6.—For the fourth time in its history the British Association met in this city on Wednesday, Aug. 3, under conditions of the most auspicious character. So far the meeting has been an excellent one, justifying the expectation that, although up to a recent date the prospects were not what might have been desired, many men of prominence would come forward at the last moment with papers and discussions to be presented. The splendid weather has brought together a very much larger attendance than was anticipated, the total number present being not far from 2,000.

Among those in attendance are many men well known throughout the scientific world for their original and important investigations in the different branches of general science. Among those best known to electrical men may be mentioned Nikola Tesla, who has returned from his sojourn on the Continent in time to attend this gathering; President Daniel C. Gilman, of Johns Hopkins University, Baltimore, Md.; Prof. S. P. Thompson, Joseph W. Swan, who is not less well known for his researches in photography than for his work in the early development of the incandescent lamp; Williams Crookes, ex-president of the Institution of Electrical Engineers; Dr. J. H. Gladstone, best known perhaps for his work on electrolysis and the chemistry of secondary batteries; Mr. Greathead, whose name has come into prominence in connection with the excavation for the City & South London Underground Electric Road; Mr. A. P. Trotter, Mr. Alabaster, Mr. C. H. W. Biggs. Prof. Schuster, Prof. Wiedermann, Prof. W. E. Ayrton, president of the Institution of Electrical Engineers; Dr. W. E. Sumpner, Mr. W. H. Preece, electrician of the Post Office Department; Prof. W. C. Unwin, of the Central Technical Institute, South Kensington, who presides over the Mechanical Science Section; Prof. H. S. Carhart, of the University of Michigan, Ann Arbor; the venerable H. L. F. von Helmholtz, of Berlin; Lord Kelvin, Dr. Oliver J. Lodge, Prof. George Forbes, Dr. Siemens and Gisbert Kapp.

The presidential address of Sir Archibald Geikie dealt with subjects of a geological nature, a field with which he is especially familiar, and in which he has obtained a world-wide reputation. It may be interesting in this connection to recall that the first meeting of the British Association held in Edinburgh, in 1834, was presided over by Sir T. M. Brisbane, the second, 16 years later, in 1850, by Sir David Brewster, while the third, 21 years later, in 1871, was guided by Sir William Thomson, now Lord Kelvin.

Prof. Wiedermann presented a paper giving some very interesting results of experimental investigations on the subject of electrical discharges, a subject that just now is attracting the attention alike of American, English and Continental scientists.

A paper giving the results of some tests of the efficiency of transformers, the joint work of Prof. W. E. Ayrton and Dr. W. E. Sumpner, was presented and proved to be of no less interest than former papers by these investigators.

Mr. W. H. Preece figured as the author of three papers. One of these dealt with condensers, another with earth currents and electrical storms, and the third with the use of secondary batteries for telegraphic purposes. All these papers presented matter which was the result of Mr. Preece's own experience and observations in connection with the management of the telegraphic service of the post office department.*

Prof. W. C. Unwin, who is presiding over the Section of Mechanical Science, gave an address on the electrical transmission of water power, describing particularly the plants that have either been installed or are in course of construction for this purpose at Schaffhausen, Frankfort, Geneva, Zurich and Niagara Falls.

The World's Columbian Exposition at Chicago came in for its share of mention through the efforts of Mr. James Dredge, of London *Engineering*, and a member of the Royal Commission having in charge the arrangements for the British exhibit at Chicago. Although Mr. Dredge himself was not present, the paper which he had prepared on this subject was presented, and, as might have been expected by those who are acquainted with the elaborate series of articles that have appeared from time to time in the columns of *Engineering*, the paper was a very comprehensive and valuable one.

Professor Forbes, who is always dealing with practical subjects, especially those of an economical nature, read a paper dealing with the burning of refuse material under the boilers of central electric lighting and power stations, treating the subject from an economical point of view.

The subject of electric locomotives was covered in a paper presented by Dr. Siemens. It was expected that a paper by Gisbert Kapp, dealing with the transmission of power by simple alternating currents, would be presented, but those who had anticipated listening to the result of Mr. Kapp's investigations along this line were disappointed, as the paper was not ready.

Although very interesting and eminently successful so far, many important papers are still to be presented at the sessions of the Association during the early part of next week. Among the papers to which those in attendance are still looking forward may be mentioned a contribution by Dr. Oliver J. Lodge on the influence of magnetization on the velocity of light; a paper by Mr. Preece on inductance; and papers by Prof. C. W. Knott on the volume effects of magnetization, by Mr. J. Gray on the theory of a perfect inductance machine, by Messrs. E. H. Barton and W. Williams on the temperature variations of the magnetic permeability of magnetite, by Prof. Schuster on primary and secondary cells in which the electrolyte is gas, by Mr. L. B. Atkinson on coal cutting by electric power, by Mr. E. H. Woods on a new electric locomotive, by one of the brothers Elmore on copper depositing, and by Mr. H. Newman Lawrence on the human body as a conductor of electricity.

It is expected that Dr. Dawson Turner will make an exhibition of experiments on the modifications of electrical resistances produced by neighboring discharges, and that Prof. H. E. J. G. du Bois, of Berlin, will contribute a paper on leaky magnetic circuits and another on the magnetic balance and its practical use.

The chief attraction, however, and the one which will probably be of the greatest interest to electricians, will be Prof. J. A. Ewing's magnetic curve traces. Prof. Ewing will exhibit an apparatus which he has designed for automatically tracing hysteresis curves. From what can be learned in advance, it is understood that this apparatus is a combination of an extraordinarily deadbeat galvanometer and an extraordinarily deadbeat magnetometer. Both these parts act upon a single mirror, which thus receives a motion in one direction proportional to H, and a motion at right angles to this proportional to B. The apparatus is arranged so that a complete cycle is gone through in a period of time as small as one-twentieth of a second, the result being a continuous, luminous hysteresis curve shown on a suitable screen. In the workshop modification of this apparatus, different samples of iron can be tested with the utmost readiness in a few seconds, the curves being traced side by side, or one on the other so as to admit of a rapid comparison of the hysteresis, permeability, etc., of the specimens.

On Monday next it is expected that the most important discussion of the Edinburgh meeting, so far as electrical science is concerned, will be taken up. This relates to electrical standards, and the discussion will be participated in by Prof. H. S. Carhart, of Michigan University; Prof. von Helmholtz, who has come from Berlin for the express purpose of taking part in this discussion; Lord Kelvin, Prof. W. E. Ayrton, W. H. Preece and Dr. Oliver J. Lodge.

In addition to this discussion, another of great importance on the subject of a national physical laboratory will be led by Dr. Oliver J. Lodge, whose interest in this subject is well known.

Those who have attended the meetings have little to complain of, either because of scarcity of papers, or because of a lack of variety in the subjects discussed in the contributions mentioned above.

*Mr. Preece's paper on secondary batteries for telegraphic purposes is given in full elsewhere in this issue of THE ELECTRICAL WORLD.

The Fire Risk in Electric Lighting.

BY W. FURLOW HOLT.

I noticed in the last issue of THE ELECTRICAL WORLD an article in reference to danger from fire in buildings which were lighted by electricity, or which have wires in them for the purpose of lighting or for power transmission, and that you request articles on the subject. I myself have had some experience in both electric and gas lighting, and from what I have seen I think there is much less danger of fire from electricity than there is from gas, assuming, of course, that the inside wiring is properly done, and the proper connections made to the main feed wire. First, all wiring when practicable should be done before the plastering or ceiling is put on the building, just as pipes for gas would be put in. The wires should all be insulated either doubly or singly, preferable the double. These insulated wires should be placed in conduits, and the conduits be fastened to the walls, or the studs or framing if it be a frame building. Wherever a joint is made in the wire it should be wrapped with some insulation which is not inflammable. Several of the insulated wire manufacturers make good insulating material for insulating the wire where joints are made. Where joints are made in the conduits they should be done the same as the wires. It is claimed that where conduits are used it is not necessary to use insulated wire, but I think it best. I don't see how there can be any danger from fire if the building is wired as above, and if connection to the feed wire or main supply wire is made on the outside of the building. It seems to me that under the above conditions electric lighting is much safer from causing a fire than gas.

The Corrosion of Lead Service Pipes.

BY ERNEST SPEIDEL.

I read with considerable interest the article and editorial on the corrosion of lead service pipe in THE ELECTRICAL WORLD of the 30th ult.

Since I was "the chemist" who did "the guessing," I want to call attention to the fact that, as far as my investigation was concerned, there was no guess work about it. My report to the Water Board was short and to the point, free from the technical points interesting to the chemist and to the electrician.

I took up the different points in my line of work and carried them to the end, finding always that chemical action alone did not do the harm, but that electricity in some form was the mischief maker. Knowing the proximity of the lead pipe to the track of the electric street railway, I consulted expert electricians as to how it was possible for the electric current to reach the pipe, and from them got their opinion; thus being doubly certain of my theory I made my report.

The chlorides spoken of were in the soil only in minute quantities, and could in no way have acted on the lead of the pipe. The electrolytic action decomposed the lead, forming an oxide of lead, which in turn combined with the chlorine that was liberated from the chlorides by the same electrical action. Had no chlorides been present, simple lead oxide only would have been formed. The corroded spots spoken of in THE ELECTRICAL WORLD all contained chloride of lead at one time.

Boyer Speed Diagrams.

BY PERCY MATTHEWS.

Permit me to call attention to a mistake which I think Mr. Charles Hewitt, Mr. H. S. Hering and Mr. Aldrich have fallen into in obtaining the mean speed of a car from the diagram of a Boyer indicator. This instrument gives a curve of instantaneous speed on a distance base, the mean ordinate of which obtained by integrating the curve is not the true mean speed, *i. e.*, the distance traversed by the car divided by the time taken to do this, but it is something else which has really little practical significance. Its value lies between the maximum and the true mean speed. Mr. Hewitt accounts for the high value of the mean speed as obtained in this way (in the issue of THE ELECTRICAL WORLD, Dec. 9, 1891) by observing that the indicator does not take into account the time the car remains stationary. The car, however, when going slowly takes a longer time to traverse the same distance than it does when going quickly. Hence the higher speeds are accentuated in taking the integrated mean from such a curve. The true mean speed may be obtained from the curve in the following manner:

Take two points, a and b, on the base of the Boyer indicator curve between which the mean speed is required. The time taken for a car to go a distance, dx, at a speed v is equal to $\frac{dx}{v}$. Consequently the total time taken for the car to go from a to $b = \int_a^b \frac{dx}{v}$, and the distance traversed $= b - a$ $\therefore$ $\frac{b-a}{\int_a^b \frac{dx}{v}}$ = the true mean speed.

Now $\int_a^b \frac{dx}{v}$ = the area of the reciprocal curve to that of the Boyer indicator between the points a and b, which may be obtained as follows: At proper intervals along the base set off ordinates along the Boyer indicator ordinates equal to their reciprocals. We thus obtain a new curve which, if we integrate, will give the reciprocal of the true mean speed. When the car stops the expression under the integral sign becomes infinity, and we cannot, therefore, include such a point, as is quite obvious since no difference is made in the shape of the curve whether the car stops for one second or for a thousand years, but a great difference is made in the mean speed. If, as I surmise, the gentlemen mentioned have really fallen into this mistake, I hope they will not take this correction unkindly.

The Strowger Automatic Telephone Exchange.

RUNNING over the inventions in the field of telephony it would seem that the one which has been patented by Mr. A. P. Strowger, and which is now controlled by the Strowger Automatic Telephone Exchange, of New York and Chicago, is one of the most ingenious. It is not a new type of telephone, or even a modification of any of the existing forms, but is rather a useful adjunct; it aims not to displace the telephone, but rather the human operator at the central exchange switchboard. In other words, it is a device to automatically make the connections in a central or sub-station and dispense entirely with the services of any employé at that place.

The method by which this is accomplished is very simple. On the telephone shelf is a row of keys, five in all, marked thousands, hundreds, tens, units, the fifth being a release key. The subscriber who wishes to place himself in communication with some one of the other hundred or thousand subscribers, taps out the desired number on the keyboard, which automatically connects his wire with that of the person with whom he wishes to speak. Suppose, for instance, that a subscriber wishes to communicate with No. 1,123. He simply presses the key marked thousands once, the key marked hundreds once, the key marked tens twice, and finally the key marked units three times. His wire is then in electrical contact with that of subscriber 1,123, and he can ring his bell and converse with him in the same way and with as much ease as if he had been wrangling with central for five or ten minutes.

The means by which this is accomplished is not as simple as the method but still is not especially complicated certainly not more so than the systems of telegraphy which are in vogue to-day.

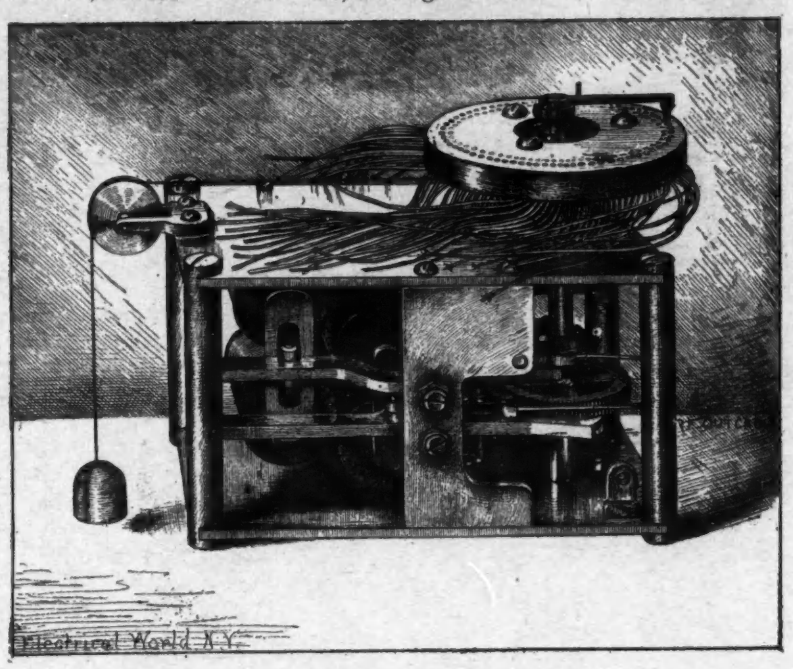


FIG. 1.—SUBSCRIBERS' INSTRUMENT IN THE CENTRAL EXCHANGE.

The whole mechanism of the Strowger patent (Fig. 1) takes up a space of only $6 \times 4 \times 4$ inches. This piece of apparatus is placed in the central exchange, and takes the place of the ordinary telephone girl. As for the subscriber's end of the line, there is nothing more there than the ordinary telephone with a row of keys upon its shelf. The mechanism at the station consists chiefly of a circular disc constructed of hard rubber, or any other suitable non-conducting material, and this is the central feature of the machine. This disc is provided with perforations in circular rows of 100 each, these rows being about one-twentieth of an inch apart. Through these perforations extend the wire connections to the main line wires, so that the wire of every subscriber in the exchange comes to this instrument, and passes up through one of the perforations, ending in a good metallic contact slightly raised above the face of the disc. If now a moving arm or needle can automatically be made to make contact with any one of these points at will, it is evident that a telephone circuit can be completed and the object of the invention attained. This is accomplished in the following manner:

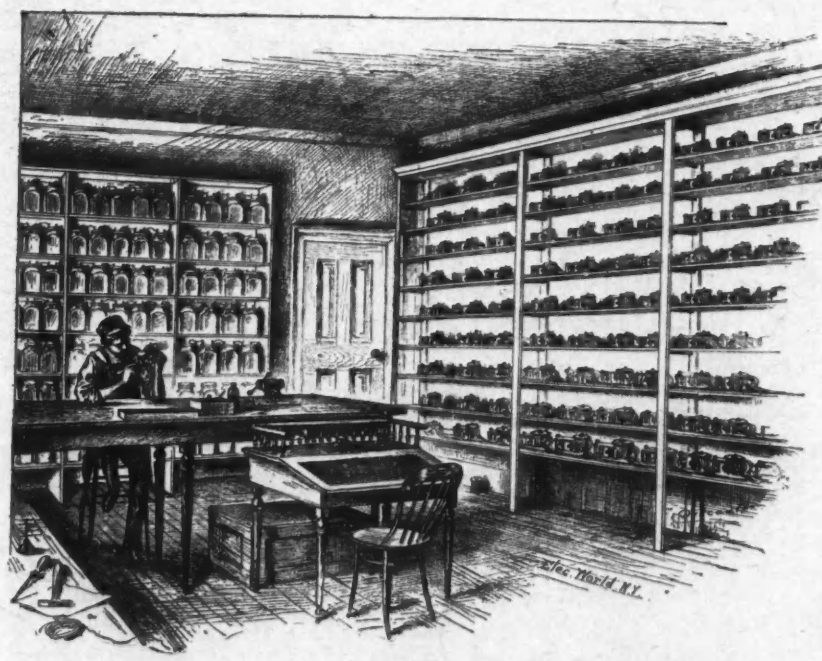


FIG. 2. GENERAL VIEW IN CENTRAL EXCHANGE.

A circuit closing arm is made in parts, of which one is a circuit closing sleeve, firmly attached to the lower end of a sleeve rod. Within the circuit closing sleeve is closely fitted a circuit closing needle held in such a manner as to be in perfect electrical contact with the wire terminal by a spring. A rod is located along the axis of the cylinder and is free to rotate and move longitudinally. The lower end of this rod is sleeved and into this is inserted the upper portion of the rachet rod. This sleeve construction allows the ratchet rod to have a longitudinal motion only, thereby keeping the ratchet teeth continuously toward the attendant pawl. The ratchet rod is provided outside of the cylinder and conveniently below it with a series of ratchet teeth, by means of which the rods are moved longitudinally. Two wheels, through which the rods extend with a feather and groove connection, are made in contact with the ratchet teeth and levers having pawls pivoted in their ends. Each lever has a vibratory movement, and is oscilated by the alternate energizing and de-energizing of an electromagnet, thereby imparting motion to its adjacent rachet teeth, and consequently the circuit closing needle. Each pressure of the push button at the exchange, made at the will of the operator, causes, through the channels thus described, the circuit closing needle to move from row to row and from wire to wire, it being understood that both ends of the wire are grounded or connected with a return tap, and also that a battery is used to generate the current. This battery is located at the sub station, between the keys and the ground. Each perforation of the cylinder is numbered with respect to an initial or starting point on the cylinder.

When any supposed conversation is ended the person hangs up his ear phone and presses the release key. This causes the magnets to be energized, attracting the armatures, thereby withdrawing the several pawls from their engagement with the rachet teeth, and allowing the circuit closer to fall and return to its initial point.

The subscriber is never isolated from the exchange. Suppose that two persons are in communication with each other, and a third wishes to speak with the first. He can tap up this number and make sufficient connection to ring his bell and call his attention to the fact that some one wishes to speak to him, so that the first subscriber can then at will release his instrument from the one with which he is in connection and connect with the third man, or he can continue his own conversation until finished, when, upon pressing the release key, he will find himself in communication with the third person. The outside party, however, cannot either speak with the other party or listen to any of the conversation, he can only obtain sufficient connection to ring his bell.

There can be no errors in the call, for an arrangement is provided on the instrument of every subscriber so that the number which he calls up is automatically registered on the front of his telephone. Suppose that a subscriber calls up No. 100, he sees 100 in plain figures on the face of his instrument, and there can be no question as to whether he is in connection with the right person.

The claim for this device is first a great saving in the cost of maintaining a telephone system. The expense of the operators required in the ordinary exchanges both day and night is entirely avoided. The costly and troublesome switchboard is also unnecessary. Then the service is claimed to be very much more satisfactory and all vexatious delays and mistakes are obviated. The subscriber can make for himself instantaneous connection and when he has finished his conversation disconnect by the pressure of a single key.

The question arises whether this system can be applied to exchanges where the subscribers number not only hundreds but thousands. It is claimed, however, that little difficulty would be experienced in this direction. The only practical change in the instrument is the enlargement of the disc and the increase in the number of wires which lead to it. This is accomplished by adding circles of perforations and consequently contacts, each circle representing 100 subscribers. As these are about one-twentieth of an inch apart, an instrument for 10,000 subscribers would be a little over five inches in radius or 10 inches in diameter. It is claimed that such an instrument can be worked with as much success as one of very much smaller size. However, the application of this invention to large central stations will be looked forward to with interest, and its success can only be assured after practical experience. Even if it should fail in the larger and busier exchanges, there is a wide field for it among the smaller local exchanges throughout the country and in private installations.

The Requirements for Safe Installation of Electric Wiring.

BY C. T. SNEDEKOR.

THE ELECTRICAL WORLD of July 23, under the heading of "Fire Risks in Electric Lighting," calls up a subject that is very interesting to me, as I have spent my entire time for nine years developing safety appliances and guards for that very purpose, and with the idea of safety from electric fires always paramount in my mind. My attention was first called to the great necessity of safety, and "absolute safety," if possible, some years ago at a fire in St. Louis, Mo. I then saw the insulation on the wires burning and carrying the fire into adjoining buildings and even across the street. Again my attention was called to a switchboard on fire, then a short circuit, etc. Of course the first was not an electric fire, but the insulation was of such a combustible nature that it made a ready pathway for the flames. In the other instances where from some of many causes the connections get overheated a more disastrous fire may occur. This is liable to occur any moment, night or day, from ways well known to electricians, but we must admit it is a subject which nearly all treat as a matter of little importance. But the fact that many of the property owners and users of electricity, either by lighting or power, do not understand the laws of electricity and are totally ignorant of the dangers arising from certain complications, and owing to assurances given by the persistent and over-confident salesman or electrical supply dealer, and his eagerness to get the order for the installation of a plant or a light, his bid of course is competitive, and therefore he is ground down, and he gives the consumer a cheap machine, cheap wire, cheap work, and the final result is a very expensive investment. We must admit that in England and Germany more precaution is taken; generally speaking work is done well or not at all. Now for the solution of the matter; the case is diagnosed, what is the cure? It is evident that the foundation corner stone of absolute safety against electric fires must start in insulation of electrical conductors. After making an exhaustive analysis of every insulated wire made in the United States, in England, Germany and France, and a knowledge of the manner in which they are made and handled, from the drawing of the copper to the finish of each and the uses for which they are designed, I find that on this fundamental point there hangs a tale. Not 50 per cent. of the wire that goes on the market to day is fit to use. Many of our electric light wires are carried into storehouses containing valuable merchandise by a tar or wax covered wire, with the poorest braiding that the unskilled hand can do hidden from immediate view by the aid of wax used to give a finish under the polishing machine. Next we find the old underwriters' wire with its "white locks" crawling in because "it's cheap." One word for the underwriters' insulated wire for inside equipment. It has been, when properly made, the safest wire for inside work, but it has not the lasting qualities required for a number one wire.

FIG. 3. — SUBSCRIBER'S TELEPHONE, SHOWING KEYBOARD.

We must have good insulation first; then the wiremen

must handle the wires carefully, they must take time, do all their work honestly, all joints must be made and covered by a competent man, and, above all, a genuine electrician who knows how the work should be done should lay out the work and inspect it. As the wire enters the building it should go through a fire-proof tube. If wire is laid through concreted spaces, the owner of the property had better pay a few dollars for lead pipe rather than suffer a loss.

I find that there is, with all the applications at hand, some cause for criticism yet with the management of the dynamo. Switches for electric light and power need as much attention as the switches of the railroads to prevent accident. Again, great reliance is placed on fuses, which in many instances are overestimated as to their capacity and safety. It is the anxious hope of insurance companies that a genuine fireproof and waterproof insulation will be found, that when properly put up can be relied upon.

My opinion is that there is absolute safety from electric fires if the conductor is sufficiently large for any required current; that the conductor is carefully covered with a first class seamless rubber insulation first, next to the wire, then a second covering over the rubber of a refractory element or compound, then carefully braided and handled in putting it in place, so that no abrasions are made, and all joints carefully insulated, that all entrances and exits are through porcelain tubes. The day is not far distant when all wires will be lead encased for concealed work in buildings.

The Effect of Temperature on Hysteresis.

A preliminary publication of the results of some experiments on this subject, by W. Kunz, appears in the *Elektrotechnishe Zeitschrift*. With equal maximum induction the hysteresis loss distinctly diminishes with increase of temperature. In a piece of soft iron the loss per cubic centimetre was 23,490 ergs when cold, 19,180 ergs at 530 degrees C. (dull red), and 21,640 ergs when cold again. Steel showed a diminution of hysteresis of about 20 per cent. when raised to 100 degrees C. The methods of measurement are unfortunately not given, but will probably be published when the author gives the results of his completed tests.

Efficiency Diagram for Dynamos, Motors, Transformers, Lines, Etc.

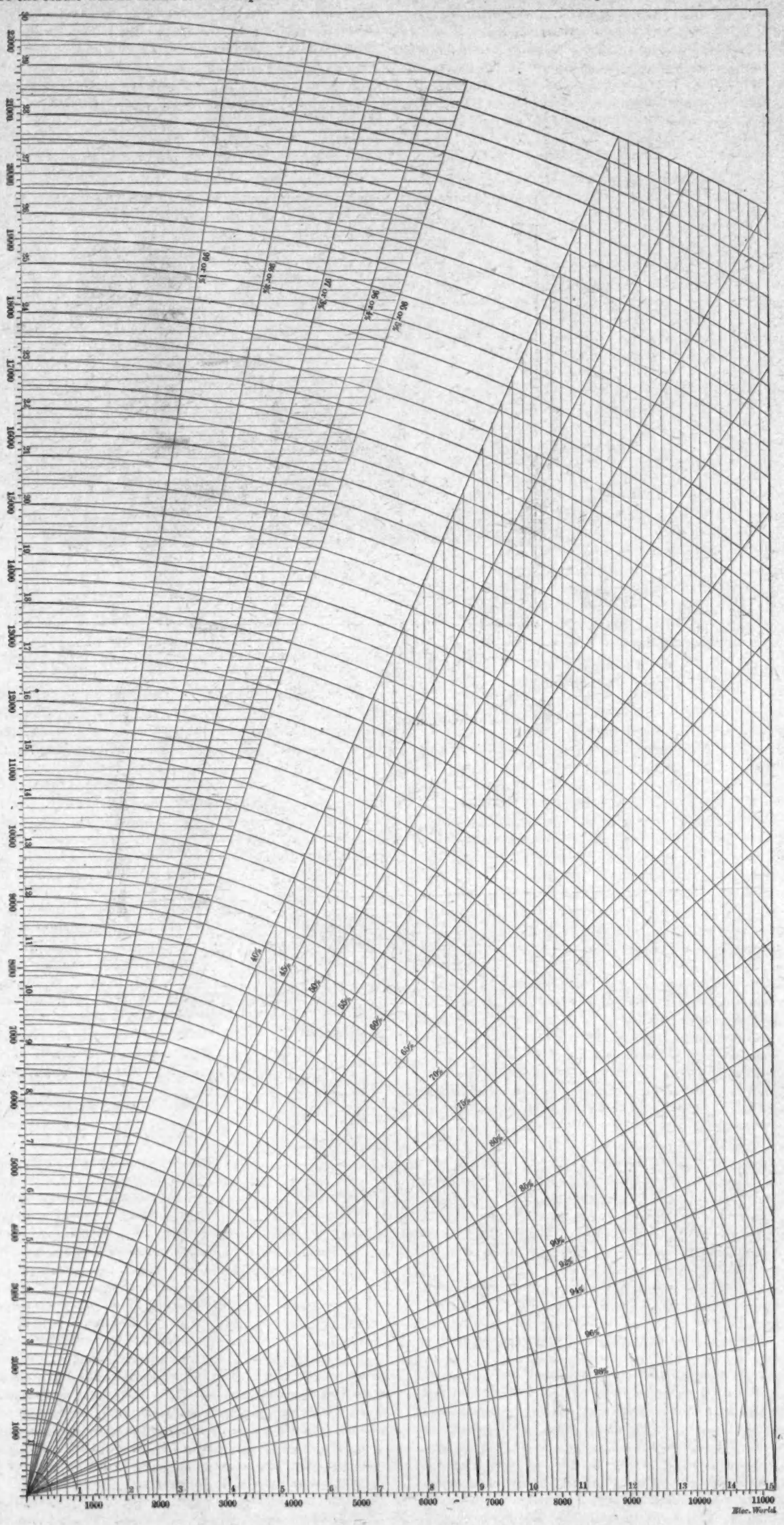
BY CARL HERING.

Very often one has to calculate how much power a dynamo or motor of a given efficiency requires when it is, giving a certain output; the same is also true of a transformer, or of a line in which there is a certain loss. The calculation is very simple when it is sufficiently accurate to find the loss by multiplying the output by the percentage of loss and then adding this to the output. For instance, if the loss in a 1,000-watt transformer is two per cent. it is equal to 20 watts, and it will then require an input of 1,020 in the primary to give an available output of 1,000 watts at the secondary terminals. This method is generally sufficiently accurate for practical cases when the loss is small, but when the losses are comparatively large, as they often are in small dynamos and motors, the error may become quite appreciable. For instance, if the loss in a thousand-watt motor is 40 per cent., as is often the case, this calculation would give 1,400 watts, while really it is 1,667. It is, of course, well understood that when the input and the loss are given, as for instance for a 1,000 watt transformer and a two per cent. loss, it is in all cases perfectly correct to calculate the output from the input by finding the loss, namely, 20 watts, and subtracting, leaving an output of 980 watts, or else to multiply the input directly by the efficiency, namely, 98 per cent. It is only in the reverse calculation, namely, in finding the input from the output, that this method is not quite correct for small losses and not at all correct for large ones. To make it correct requires a division instead of a multiplication.

But in either case, and more especially in the latter, it is still simpler not to have any calculation to make at all, but to find the result directly from a diagram on which the calculation is performed by the simple act of following a line to its intersection, which not only saves time but the result may be relied upon, while in an arithmetical calculation one is never sure that there has been no mistake made, until the calculation is repeated. Of course a table might be calculated to cover the same results, but a straight line diagram has the advantage that it is easily made by any one, that the liabilities of making errors are not so great, and that a new intermediate set of results for a special case may readily be interpolated.

Such a diagram is shown in the adjoining cut. To find the power required to run a motor, for instance, which develops a certain power, say 4 h. p., at an efficiency of 80 per cent.: Find 4 h. p. on the horizontal scale, follow up along the vertical line to its intersection with the diagonal representing 80 per cent., then the distance along the diagonal to the centre is the required horse power; to determine this distance without measurement merely follow the circle through that point back to the horizontal (or the vertical) scale, then the reading there, namely, 5 h. p., is the required result; the scales are the same for both the horizontals and diagonals. The latter operation of following the nearest circle back to the scale is so easy that it is practically equivalent to reading a scale directly on the diagonals themselves. To introduce such scales on the diagonals would burden the diagram with too many lines, but they may readily be added to advantage by any one for any efficiency at which many calculations will be required.

The reverse calculation may also be performed just as readily. For instance, if the dynamo consumes 5 h. p. and has an efficiency of 80 per cent., what is the output? From 5 h. p follow up along the circle to the 80 per cent. diagonal, thence down along the vertical line to the scale, where the result will be found to be 4 h. p.



EFFICIENCY DIAGRAM FOR DYNAMOS, MOTORS, TRANSFORMERS, LINES, ETC.

To find the power required to run a dynamo (or motor, etc.,) at a given output and efficiency: From the output on the horizontal scale follow up to the efficiency diagonal, thence along the nearest circle back to the same scale.

The horizontal scale is given both in horse power and in watts, so either or both may be used; it therefore answers also as a conversion table for watts into horse powers and the reverse. If, for instance, the output of the dynamo is given as is usual in watts, the input or power at the pulley may be read off directly in mechanical horse power; in a motor the reverse is usually the case, the output is in horse power and the input in watts.

The scales read in horse powers and tenths, but they may, of course, be used for any multiples, such as 2, 10, 100 times the readings, thus covering an unlimited range. The horizontal and vertical scales are the same; either may be used. For high efficiencies or small losses the greater range of the vertical scale was taken advantage of by inserting a second set of efficiency lines near the verti-

A third calculation may also be readily made. Having a given output and input, required the efficiency. Follow the input (the larger of the two values) up along the circle and the output up along the vertical line, to their intersection, then the diagonal passing through this point is the required efficiency.

cal scale. They are used with the vertical scale precisely as the others are used with the horizontal scale.

To interpolate additional diagonals it will be sufficiently accurate for most purposes to assume proportionate differences on the vertical lines and insert the diagonals accordingly; for instance, 82½ per cent. diagonal would be about half way (measured vertically) between those for 80 and 85 per cent., slightly nearer the former.

The New Postal Telegraph Building.

So great has been the increase in the volume of business handled by the Postal Telegraph-Cable Company that the necessity for more commodious and convenient quarters for the executive and operating departments has become imperative, and the officials of the company have for some time past been engaged in arranging to secure a building of its own.

The corner of Broadway and Murray streets was selected as the best site for the purpose, since this is at the centre of down-town business interests, near the newspaper offices, and convenient of access by all lines of elevated railroads, horse cars, ferries and the bridge, while the frontage on City Hall Park and Murray street insures ample light and air.

Immediately upon the selection of the location negotiations for the purchase of the necessary ground were completed and plans for the new building prepared. Already the old buildings have been torn down and work on the foundations for the new structure is well under way and progressing rapidly.

The accompanying illustration is from the architect's drawing, and shows the building as it will be when finshed. It will be 14 stories high and will have a frontage of about 75 feet on Broadway by 150 feet on Murray street, with an L of 30 × 50 feet at the rear end.

The frame will be of steel, and the walls to the fifth story will be of a fine quality of Indiana limestone, the upper stories of gray brick, with terra cotta trimmings to correspond. The interior finish will be in keeping with the handsome exterior, and no efforts are being spared to make all of the fittings and arrangements of the latest and most improved modern design.

The sub-basement will be 12 feet deep, commodious, well lighted and artificially ventilated. Here will be located the engine and dynamo rooms. The boiler room will be in the extension of the sub-basement, and will be 14 feet deep. The heating apparatus and the two dynamo plants for lighting the building and furnishing current for the wires will be of the latest improved designs and arranged with regard to convenience and the comfort of the men in charge. The basement will be used for the supply department of the company and for storage rooms, and will be equipped with every facility for packing and handling material. It is also intended to utilize a portion of the basement for safe deposit vaults.

The first or ground floor will be used for the receiving and delivery departments of the company, and possibly a portion of it may be leased for business purposes; the second floor will probably be occupied by a bank; and other floors, to and including the tenth, will be rented for offices. Applications for a large number of these offices have already been received. The eleventh floor will be retained by the company for its executive offices and for the executive offices of the Commercial Cable Company, which is allied to the Postal company.

The general operating department will occupy the entire twelfth floor. Here, again, the arrangements will be made with a view to attain the highest facilities for handling the business and to provide for the comfort of the employés. The ceiling will be 18 feet high, and the exposure of the east, south, west and part of the north sides will insure perfect light and ventilation. The apparatus will be new, specially designed for this office, and it is expected that the operating department will excel even the splendidly equipped operating room of the Western Union company, recently completed.

The thirteenth floor will be used to accommodate the general clerical force, and also for coat rooms, lavatories, etc., for the operating and clerical departments. It is expected that the fourteenth story will be occupied by a business men's club and restaurant for employés, but these arrangements have not yet been concluded.

As a whole the building will be one of the best examples of modern architecture in the city, and in convenience of arrangement, excellence of construction and beauty of appearance will be second to none. The drawing of the plans and the work of construction and arrangement are under the supervision of Mr. A. B. Chandler, the president of the Postal company, to whom, in great measure, credit is due, not only for the completeness of the new building, but for the success of the company which has made the erection of the building possible. Mr. Chandler is assisted in the direction of the new work by a building committee, consisting of Mr. W. H. Baker, vice-president; Mr. E. C. Platt, treasurer of the Postal company, and Mr. Geo. C. Ward, vice-president and general manager of the Commercial Cable Company. Messrs Geo. W. Harding and Gooch are the architects and have charge of the details of plans and construction. It is expected that the new quarters will be ready for occupancy in the summer of 1893, and we congratulate the company's employés on their prospects for improving their present fine service with the aid of the most perfect appliances and in such comfortable and convenient quarters for telegraph purposes.

THE NEW POSTAL TELEGRAPH BUILDING.

On the Applications of Electricity in the Royal Dockyards and Navy.—I.*

BY HENRY E. DEADMAN,
Chief Constructor, Portsmouth Dockyard.

This is an age of electricity, and the fact is well exemplified on board a modern battle ship of the Royal Navy. Some of the applications of electricity in the naval service do not come within the scope of ordinary mercantile practice; and in the case of those which do, the naval experience is of a special kind, and may be of some value to those outside the service. A statement therefore of naval methods and practice up to date may not be without interest and instruction to the members of this Institution. At the present time visitors to Portsmouth dockyard will probably be surprised, if not disappointed, at the somewhat primitive character of the workshops devoted to the electrical testing and construction. This branch of work was commenced in a very small way about seventeen years ago, and found a temporary home in a small shed which had been previously used for a different purpose. As the work from time to time has grown, this shed has been enlarged as far as available space would permit. Designs have been prepared for a more substantial and suitable building, in the hope that in time the Admiralty will be able to devote sufficient money to providing a proper habitation for this important branch of dockyard work.

The larger proportion of the plant required for electric installations in the navy is not made in the dockyard. Formerly all dynamos and their engines were obtained entirely by contract: but recently five sets of these have been designed and constructed in the dockyard. After patterns of the smaller fittings have been fixed, the supply of these, also in bulk, has generally been obtained by contract. There is, however, a great deal of work left to be done in the dockyard in testing and installing these fittings in the ships, in carrying out repairs, and in devising and preparing patterns of new fittings to meet the constantly growing requirements of the navy. There is also some work, which, for obvious reasons, is confined to the royal workshops.

*A paper read before the Institution of Mechanical Engineers at Portsmouth, England.

The applications of electricity in the navy may be dealt with under the following heads: (1) Search lights; (2) internal lighting of ships, including temporary installations in ships building and repairing; (3) torpedo and gun circuits; (4) electric communication; (5) other applications.

1.—SEARCH LIGHTS.

The introduction of the search light, without which no modern war ship or torpedo boat would be considered complete, dates from 1876, and the first vessel in the navy fitted with a search light apparatus was the Minotaur. Some experiments had been carried on in the previous year by Messrs. Wilde & Co., of Manchester, on board the gunboat Comet; and this proved so far satisfactory that a complete plant was ordered and fitted on board the Minotaur. The dynamo employed was one of the alternating current type with 32 magnets, and it was driven at about 400 revolutions by a belt from an auxiliary pumping engine. The projector was of a primitive type, and pedestals were fixed in three different places, from any one of which the same projector could be used. It was fitted with a parabolic reflector and with dioptric and diverging lenses. A diaphragm was also provided for enabling flashing signals to be made. The lamp employed was Wilde's, and was a vertical one. The carbon rods were square in section, and their holders were made to slide on two pillars, and were moved up and down by a central pillar with a screw thread cut in it. The lamp was hand regulated, and one lead was put to earth. The Téméraire in the same year was next fitted in a similar manner, with the exception that a Mangin projector was introduced, fitted with Wilde's lamp, lens, etc. In the next year, 1877, the Dreadnaught, Neptune, and several other vessels were fitted with the same class of apparatus.

In 1878 direct driving was first introduced. In this year Messrs. Wilde & Co. coupled their machines to engines made by Brotherhood and by Chadwick of Manchester. The dynamo was also improved, so as to be able to maintain two arc search lights at one time. In the same year, also, the Triumph was fitted by Messrs. Siemens Brothers with a search light installation. The dynamos were four in number, of horizontal type, arranged in two pairs, and each connected in parallel to one circuit. A switchboard was fitted, for enabling any two of these dynamos to be coupled up together on any circuit. It consisted of a wood base with two sets of bars at right angles to each other, one set on the top of the base, and the other underneath. One set of bars was connected to the dynamos, and the other to the circuits. At their intersections these bars could be connected as required, by means of suitable plugs. The projector used was a Siemens holophote, which was heavy and clumsy, being made largely of cast iron. It was fitted with diverging and dioptric lenses; of these the latter was composed of concentric glass rings of triangular section, held in a metal frame. It had also a flashing arrangement. The lamp used was one of the Siemens self-regulating type, and had a small mirror fixed to it. It was complicated, and frequently got out of order. The carbons were apt to stick together, and the lamp was sensitive to any slight variation in speed of the dynamos. This lamp did not come into general use.

Subsequently the Gramme dynamo was introduced for search lighting by Messrs. Sautter Lemonnier, of Paris; and in 1881 the Inflexible was fitted with this dynamo. In this installation the Mangin projector was used, with a Mangin mirror instead of the dioptric lens. The lamp was hand regulated and inclined. The Gramme dynamo has since been superseded by others of later make; but the Mangin mirror and the inclined hand lamp survive, and became the standard service fittings.

Naval Service Projector.—Out of these earlier attempts the modern naval service projector has gradually been evolved, which has now become familiar to most persons. It consists of a cylindrical lantern made of very thin steel, with a silvered glass parabolic mirror at the back end, in the focus of which an arc light is produced between two carbon sticks, held in what is known as an inclined hand lamp, the carbons standing at an angle of about 70 degrees to the axis of the mirror. The feeding of the carbons is not automatic, but is accomplished by hand, and the lantern is so suspended that it has motion on its pedestal through the whole circuit in azimuth and through about 60 degrees in altitude. During its motion the electrical connections are kept up by suitable rubbing contacts. A switch is fitted in the pedestal for switching the current on and off. The circuit wires, main and return, are brought from the

main switchboard to the switch on the pedestal, thence to the rubbing contacts, and finally pass close together up one of the hollow arms of the lantern support, and through the trunnion bearing to two springs at the bottom of the lamp box. The lamp when put in makes contact with these springs, and completes the circuit through the carbons. Two sizes of these projectors are used in the naval service, a larger with a 24-inch mirror for ships, and a smaller with a 20-inch mirror for torpedo boats. The parabolic mirror in these projectors converges the rays into a powerful and penetrating cylindrical beam of light. At the front end of the lantern, diverging lenses can be attached for spreading the beam over a larger surface when desired; or a flashing screen can be affixed for signaling purposes.

The two most important parts of these projectors for the production of a good and steady beam are of course the reflecting mirror and the carbons. For the supply of these articles the naval service was until recently dependent entirely upon French manufacturing firms. The Admiralty, fully alive to the dilemma in which this country might under certain circumstances be placed, have sought to induce English manufacturers to enter into competition with the French firms for the supply of these articles; and everything of this kind which has been offered with the slightest promise of success has been fully and carefully tested at Portsmouth. The English manufacturers have no doubt had no easy task to accomplish; for, disregarding cost, the French mirrors and carbons left nothing to be desired, and are still the standards to which all others are referred.

Mirrors.—As regards mirrors, the qualities required are three: First, that they shall project a cylindrical, sharply defined and homogeneous beam of light of great intensity and penetrative power; second, that when in operation they shall not be liable to crack by contact with water, in the form either of rain or of sea water spray, or by a blast of cold air; third, that they shall resist the concussion caused by the discharge of heavy guns. These qualities should be combined at a moderate cost if possible, although efficiency is the primary consideration. Thus far mirrors have been submitted for trial by six different English makers, and by others specimens are being prepared for future trial. From among these at least one successful English specimen has been obtained which compares in all points favorably with the French production, and one-half of the supply for the navy will this year be ordered from the firm producing this specimen.

Carbons.—With regard to English carbons, the results were for a long time disheartening; even after several attempts by the same firm none of the specimens submitted for test approached in efficiency those of French make. The three qualities required in good carbons are that they shall maintain a steady arc without flaming or excessive hissing; that they shall be perfectly pure and homogeneous in structure, and shall preserve a well formed crater on the positive carbon and a well formed point on the negative; and that the waste shall be steady and uniform, without cracking or crumbling. A certain amount of success has already crowned the persevering efforts of English manufacturers. Although the English carbons are not even yet fully equal to those previously obtained from France, it is hoped they will soon come sufficiently near that standard to make them acceptable for use in the navy.

Projector Requirements.—The present service projector requires at least one man close to it to direct the beam of light in any desired direction, and also to feed and adjust the carbons as necessary. This is a disadvantage, because the position of a search light is evidently one affording a good mark for an enemy's fire, and is a bad position for observing the object illuminated; and it would be an advantage if the projector could be entirely manipulated from a protected position at some distance—for instance from the ordinary conning tower. For this purpose two requisites are necessary: First, a good automatic lamp, and second, an efficient motor for giving the necessary movements to the projector. It is to these two improvements that attention is now being given.

A good practical automatic lamp is the first necessity; without this a man must be stationed at the projector to feed the carbons, and being there he can also direct the beam of light. Several automatic lamps have been tested, but none have as yet been adopted for general use. One lamp, in which the carbons are regulated by a small electric motor in a shunt circuit, is promising; but in its final form it has not yet been returned from the makers. The field, however, is still open for invention in this direction.

Experiments have also been made with an electric motor attached to the service projector, by which the movements of the latter can be directed and controlled from a distance. The results are highly satisfactory, but, as already stated, the invention is not likely to be brought largely into use until it can be combined with a satisfactory automatic lamp. Recently a wheeled carriage has been introduced for using a ship's projector on shore.

Comparison of Vacua of Glow Lamps.

An interesting investigation has been made by C. Boccali on this subject, the results of which are published in a recent number of the *Elektrotechnische Zeitschrift*. The tests were made on the assumption that with constant supply of heat the temperature to which the filament of a lamp will arise depends, other things being equal, on the vacuum. The author uses a bridge method, with the lamp under test as one arm. The resistance of the lamp is first taken in an oil bath at 50 degrees, then at 20 degrees; care being taken in both these cases to use as small a battery current as possible—about 0.3 milliampère. The current used in the bridge is then raised by an adjustable resistance in the battery circuit, till keeping the oil bath constant at 20 degrees, the filament is shown by its resistance to be 50 degrees. The current being measured, the number of watts required to keep the filament at 50 degrees under these circumstances is known, and applying the same tests to other lamps of the same make, size, etc., a comparative idea of their respective vacua is obtained. Tests on seven similar lamps of 65 volts and 16 c. p. show that the milliwatts required vary from 7.8 to as high as 14.8. The lower the watts, presumably, the better the vacuum.

The Will of Cyrus W. Field.

Cyrus W. Field, at the time of his death, had in his possession a great many articles of historic value, which his connection with the laying of the Atlantic cable and his large acquaintance both at home and abroad had brought to him. Considerable interest has been manifested in the final disposition of these relics and the following extracts from his will furnish some interesting information on this point:

"I give to the New York Historical Society the six oil paintings and forty-seven water-color paintings belonging to me, which illustrate scenes connected with the laying of the Atlantic telegraph cable.

"I also give to such of my children as may survive me, other than my daughter Alice D. Field and my son Edward M. Field (to be divided between them by mutual agreement, if possible, otherwise by my executors by lot), the following articles of personal property belonging to me:

"The gold medal presented to me by the unanimous vote of the Congress of the United States; the duplicate of the same, the original having been lost or mislaid in the Treasury Department at Washington, but afterward found; the gold snuff box presented to me by the City of New York; with the freedom of the city; the Grand Prize Medal presented to me by the Exposition Universale of 1867 at Paris, the gold medal presented to me by the Chamber of Commerce of the State of New York the gold medal presented to me by the merchants of New York; the gold medal presented to me by the American Chamber of Commerce of Liverpool; the gold medal presented to me by the State of Wisconsin; the decoration presented to me by Victor Emanuel, King of Italy; the silver service presented to me by my friend George Peabody, of London; the silver epergne presented to me by my friends Peter Cooper, Moses Taylor, Marshall O. Roberts and Wilson G. Hunt, who were for many years co-directors with me in the New York, Newfoundland and London Telegraph Company. the dining table on which the contract was signed March 10, 1854, for connecting Europe and America by submarine telegraph cable, and also the chairs and other articles of furniture belonging to the same set with the table; the American and English flags wrought into one, which floated at the masthead of the steamship Niagara in the cable expeditions of 1857 and 1858, and of the English steamship Great Eastern while the cables of 1865 and 1866 were laid."

The Comparative Output of the Direct, Alternating and Drehstrom Armatures.

In a paper on this subject read before the Elektrotechnische Verein of Berlin and reported in the *Elektrotechnische Zeitschrift*, H. George points out that Dubois Reymond showed in 1891 that, in a ring excited by several multiphase coils, the intensity of magnetization increased with the number of coils; the total winding being evenly distributed over the ring, and the number of turns and mean current strength being kept constant. The author takes the reciprocal case, and shows that, given a rotary field in an iron ring, the E. M F. set up in coils surrounding it, and therefore the work, increases with the number of coils. Taking the work, when the number of coils is infinity, as 100 per cent., that with two coils is 63.6 per cent., with four coils 90 per cent., and 12 coils 98.8 per cent. The same armature with the same winding and direct current would be 90 per cent. An ordinary Siemens & Halske "H" machine was experimented with; the pole piece bored somewhat oval, so as to get a strong field in the middle, weakening toward the side. The winding on the armature was arranged so that it could be coupled up to collector rings to give either direct current, or as a three or six-coil drehstrom. The ratio of the E. M. Fs. obtained with the three arrangements was within two per cent. of the calculation.

Dobrowolski, in the discussion upon his paper, objected to comparisons between the output of the same machine for direct and other currents; he claimed that, as a rule, a machine was built and was suitable for one purpose only. He called attention, however, to a multipolar direct current machine of the Allgemeine company which gave 11,000 watts; the same field magnet with a drehstrom armature gave an output of 30,000 watts.

Electrical Exhibits for the Detroit Exposition.

George F. Fisher, chief of the electrical department of the Detroit Exposition, has completed arrangements with the following electrical concerns, whose outputs will be represented at the coming exposition: Standard Electric Company, of Chicago, arc lighting apparatus; National Electric Manufacturing Company, Eau Claire, Wis., alternating incandescent and direct current incandescent apparatus; Fisher Electrical Company, Detroit, direct current incandescent apparatus; Standard Electric Works, Detroit, storage batteries; Detroit Motor Company, electric motors; Ries Electric Specialty Company, Baltimore, Md.; Electric Engineer and Supply Company, Syracuse, N. Y.; National Carbon Company, Cleveland; Okonite Company, New York; Steuben Lamp Company, Hornellsville, N. Y.; Backus Fan and Motor Company, Newark, N. J.: Electric Construction and Supply Company, New York; Cutter Electric Manufacturing Company, Philadelphia; Phœnix Glass Company, Pittsburgh; Racine Hardware Manufacturing Company, Racine, Wis.; Otis Bros., New York; Consolidated Electric Manufacturing Company, Boston; THE ELECTRICAL WORLD; International Conduit and Insulation Company, New York; Bunnell & Co., New York; Schuckert & Co., Hamburg, Germany.

Superintendent Chase, of the Commercial Electric Company, is now on the grounds starting the construction of the lighting plant, which will consist of 300 arcs and 1,500 incandescent lights. The electrical exhibit and lighting plant will occupy 160 feet front on the main floor of the exposition building.

The Magnetization of Iron in an Alternating Field.

In a recent number of *Beiblätter* Messrs. Gerosa and Finzi have published the results of investigations on this subject. The authors have previously shown that there is no turning point in the magnetization curve of iron traversed by an alternating current, and at the same time placed in a magnetizing spiral conveying alternate current. The maximum of magnetization is also less. The tests described in this paper were made with a Bellati dynamometer, at one end of the needle of which was fixed a magnetizing spiral (1,000 per min.) containing a bundle of hard-drawn iron wire. A bundle of the same wires annealed was also tested. At the other end of the needle of the dynamometer was a compensating spiral similar to the first, but without a core, and this was movable by a micrometer screw. The results showed no hysteresis for either hard or soft wires; the temporary moment of the annealed was the greater; and both approached the maximum of magnetization much sooner, though the actual moments were less with direct current.

Telegraph and Telephone Statistics.

Our esteemed contemporary the *Journal Télégraphique* gives a very interesting general summary of the telegraph and telephone statistics of European and non-European countries, of which the following is an abstract:

The European telegraph system comprised 407,080 miles of line at the beginning of 1891. The telegraph mileage for North and South America, the Australian colonies, and other extra-European countries amounted at the same date to 342,550. Adding to the totals the 145,030 miles of submarine cable, we obtain a grand total of 894,660 miles. The number of telegraph offices open in Europe is 67,465, and outside Europe 31,000, a grand total of 98,465. The number of instruments in use is 101,500 for Europe, and 71,000 for countries outside Europe, a grand total of 172,050. As to telegraphic traffic, the figures relating to it are as below:

Place.	Number of messages.			Approximate Receipts. $
	Inland.	International.	Total.	
European countries.....	162,996,000	44,599,000	207,595,000	51,000,000
Extra-European countries	75,547,000	12,875,000	88,422,000	53,000,000
	238,543,000	57,474,000	296,017,000	104,000,000

The following table gives telephone statistics of interest:

Country.	Number of towns provided with exchanges.	Length of wire in kilometres.	No. of subscribers.	No. of conversations.	Average No. of conversations per diem per subscriber.
Germany.....	260	100,396	59,086	223,852,925	12.6
Italy.....	**42**	**18,128**	**10,481**	**16,709,000**	5
Japan.....	2	1,680	560	680,000	4
Austria.....	42	2,267	1,252	540,000	1.5
"	**11**	**32,511**	**7,659**	**12,437,000**	5
Sweden.....	126	6,722	4,767	8,157,000	5.5
"	**213**	**27,536**	**14,600**	**13,500,000**	3
Switzerland...	92	17,067	10,945	5,350,000	4
Luxembourg..	43	343	811	562,000	2.5
Belgium.....	4	821	199	22,128	0.5
"	**11**	**10,600**	**5,846**	**12,000,000**	6.5
Hungary.....	4	3,126	1,540	6,020,000	13
"	**8**	**790**	**641**	**800,000**	4
Spain.....	6	370	70	.....	.....
"	**29**	**17,504**	**7,022**	**4,200,000**	2
Norway.....	32	6,545	5,110	6,000,000	4

(The figures printed in bold-faced type relate to private companies.)

The Electric Percussion Drill in Theory and Practice.*

BY HARRY N. MARVIN.

Wherever rock is to be excavated, in mining, tunneling, or quarrying, there of necessity we find the percussion drill. Until about a year ago two types of drills held the field, the hand drill and the direct acting steam or air drill. With the extension of electrical methods of power transmission to mining operations came the urgent demand for an electrically operated percussion drill. The mechanical and electrical requirements of this machine are particularly severe; it is called upon to continuously endure an action that is, in almost all other machinery, studiously avoided, namely, a practically uncushioned reciprocation and a blow upon substances harder than cast iron. The general requirements of an electric percussion drill for mining work are that it shall be light enough to be quickly handled by two or three men; it must be powerful enough to compete with an air drill that absorbs 8 or 10 h. p.; it must be so simple in its design that it can readily be repaired by an ordinary mechanic without electrical experience; it must be so constructed that the complete machine and its several parts can be soaked in mud and water without injury; it should be incapable of burning out; it must be able to endure almost any amount of the roughest handling without injury, and the materials employed should be as little subject to crystallization as possible. My experience suggests the following elements of construction to be avoided: Traveling conductors, commutating or current shifting devices, sliding contacts, spring contacts, cotton insulated wire, and all insulating material capable of carbonization; switches, lamination of the moving parts, close fittings and joints liable to be impaired by considerable wear, all constructions liable to be impaired by careless or unskilled attention. For the benefit of those unfamiliar with the actions of the air drill I will state that the general practice at present is to give the machine a stroke of from five to seven inches, to strike as nearly as possible an uncushioned blow upon the rock, and to make as many blows per minute as the power applied will develop, usually from 200 to 400 per minute. It is found that a stroke of about five inches is necessary to properly free the hole from mud.

In the electrical solution of the problem the solenoid and plunger afford the simplest method of developing this action, and most of the work in this field has been confined to this line. After much experimental work with divided solenoids and commutating devices mounted upon the drill I abandoned these methods, and in 1888 devised the system of operation that is at present rather well known, but for clearness this may be illustrated.

Fig. 1 shows an ordinary continuous current dynamo having two opposite points of its armature connected to a solid collecting ring and a half ring respectively. The outer terminals of the drill coils M^1 and M^2 are connected by line wires to the two brushes alternately bearing upon the half ring. The inner terminals of the coil are joined and led to the solid ring. It appears that as the armature revolves current impulses are directed into the drill coils in alternation, causing a reciprocation of the plunger in synchronism with the dynamo armature. It will be noticed that the action here closely resembles the action of a steam engine, force being exerted first in one direction and then in the other, one end of the cylinder being idle while the other end is active. Of course connections are such that the polarity of the plunger is never reversed. This system simplifies to the utmost the construction of the drill, and enables it to be so designed as to satisfy all of the conditions before mentioned. The complications of this system are more apparent in theory than in practice. Three wires are required, but once placed they give no further trouble. The generator can be used to develop continuous current and pulsating currents at the same time if desired, but I believe that it is better practice to use a separately excited drill generator without regular commutator. The machine then becomes extremely simple, as shown by Fig. 2. I have found it desirable to run these drills at a speed of about 400 per minute, a rather low speed for small dynamos. This difficulty may be avoided at the expense of simplicity in several ways. One method is shown in Fig 3. The regular commutator of a continuous current armature is equipped with a pair of revolving brushes B, B^1, one of which connects to the solid ring of the drill circuit commutator, and the other to the half ring. In this manner pulsations are developed in the drill circuit as the brushes B, B^1 are rotated, and with a frequency entirely independent of the armature speed. With this arrangement we are also able to take off 100-volt alternating currents from a commutator that is also supplying a 500-volt continuous current circuit, by spacing the brushes B and B^1 an amount less than 180 degrees.

Another method of reducing the frequency of the pulsations is shown in Fig. 4, where the drill commutator is geared to the dynamo shaft, reducing the frequency to one-half the speed of the generator.

The general character of the impressed E. M. F. in the two drill circuit in the above system is shown in Fig. 5, curve A showing the voltage over the upper coil, and curve B showing the voltage over the lower coil.

A method of operation by which a somewhat different curve is obtained is shown in Fig. 6. It will be noticed that here current is admitted to the drill circuits when the voltage is at a maximum, the curve of impressed E. M. F. being generally as shown. The general plan of admitting the current alternately to the two drill circuits, one circuit being idle while the other is active, characterize all the above methods. This may be called plan A.

I have devised a method for effecting this without commutation, as shown in Fig. 7. Here one wire from a simple alternator is led to the drill while the other wire passes through the secondaries of two converters C, C^1. The cores

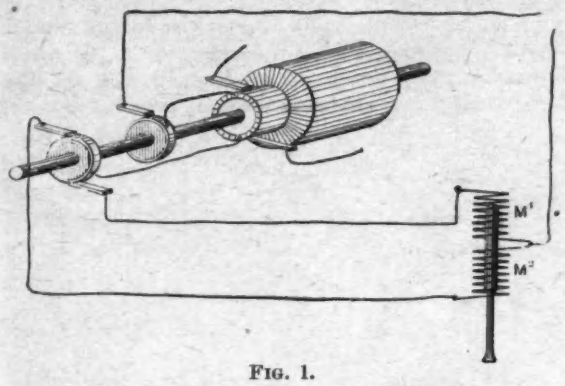


FIG. 1.

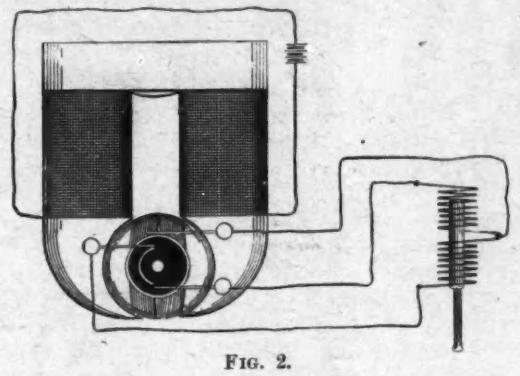


FIG. 2.

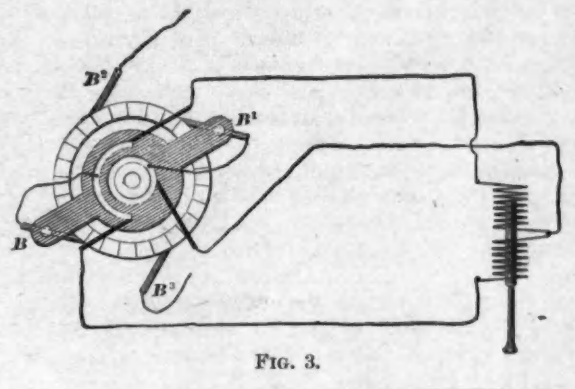


FIG. 3.

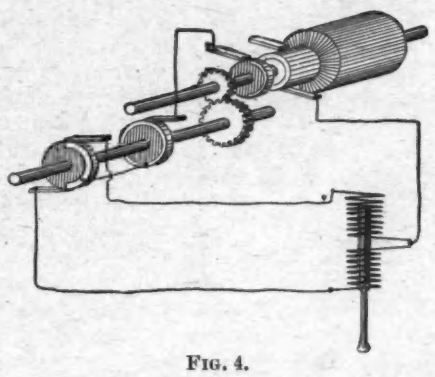


FIG. 4.

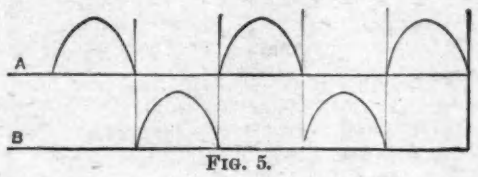


FIG. 5.

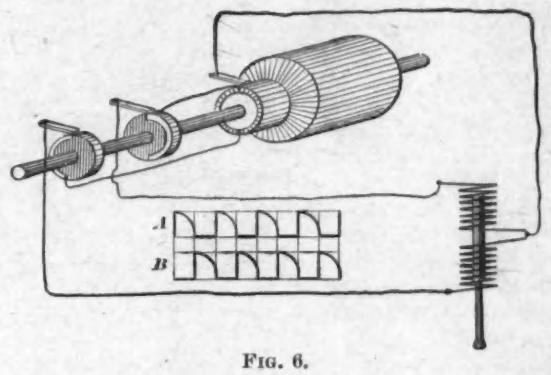


FIG. 6.

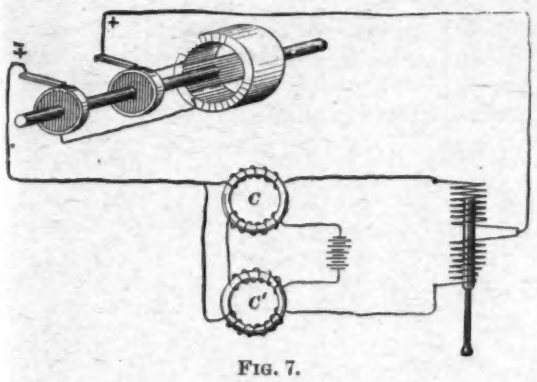


FIG. 7.

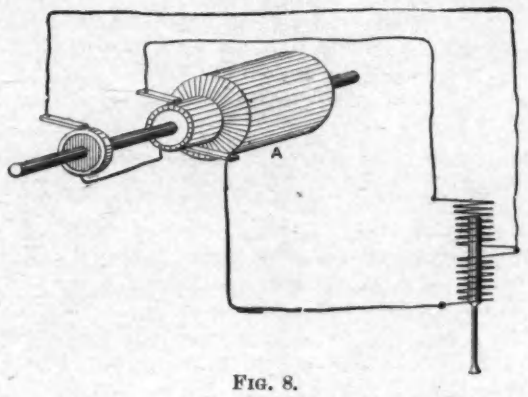


FIG. 8.

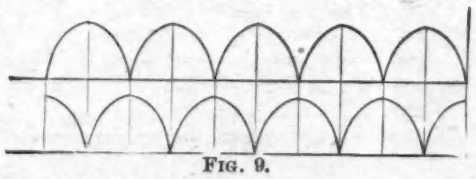


FIG. 9.

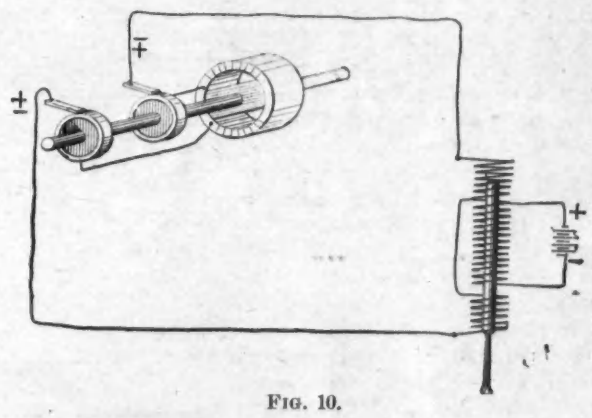


FIG. 10.

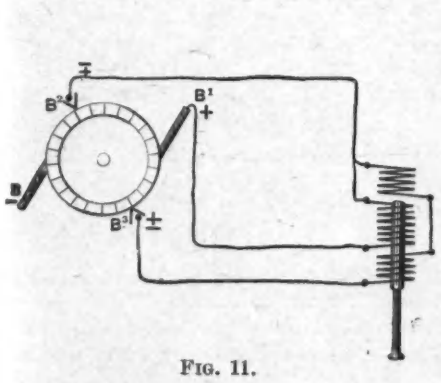


FIG. 11.

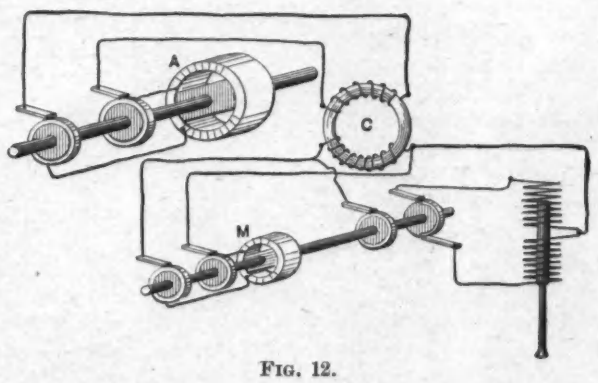


FIG. 12.

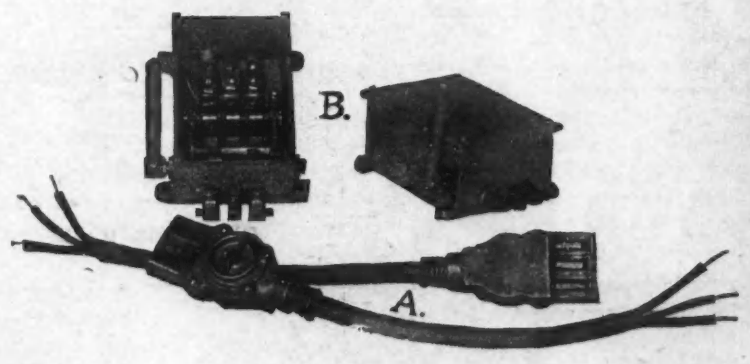


FIG. 17.

DIAGRAMS ILLUSTRATING THE ACTION OF THE PERCUSSION DRILL.

*A paper read before the American Institute of Electrical Engineers.

of these converters are continuously saturated by continuous currents in the primary coils as shown, the windings of the converters being opposite. When current endeavors to pass through these it is checked considerably in the converter whose magnetism it tends to reduce and to a much less degree by the converter whose magnetism it tends to increase. A reverse current is opposed by the other converter and thus pulsations of one polarity are strong in one coil while those of the reverse polarity are strong in the other drill coil. This would not probably be a very efficient method.

Another general plan of drill operation, which I will call plan B, had been developed to some exent by the late Mr. Van Depoele. This is based on a difference of phase of current in the two coils, and is shown in its simplest form in Fig. 8. The two outer drill wires are connected to the two regular brushes of the armature *A* and the middle wire connects to the solid ring connected to the one point of the armature. As the armature revolves current rises in one drill coil and falls in the other, producing the reciprocation of the plunger. The voltage curves for this type of machine are shown by Fig. 9. The armature giving two alternating currents of 90 degrees difference of phase may also be used, but with the disadvantage of reversing the polarity of the drill plunger. The above appears to be less efficient than plan A for the reason that the drill coils are constantly working against each other, and being heated up by current opposing the action of the drill.

A third plan of operation, which we may call plan C, is that devised by Messrs. Siemens & Halske, and shown in Fig. 10. Here three coils are used in the drill, the middle coil being excited by a continuous current, and the two end coils by an alternating current of proper frequency. The function of the middle coil is to maintain a constant polarity in the bar, and the motion is effected by the effort of the two end coils. In this system both motor coils are continuously excited, as in plan B, but there appears to be less waste of energy.

Aside from the extra complication of drill construction, it is questionable if as much power can be obtained from a given weight of wire with this arrangement as can be realized on plan A. It must be borne in mind that in these machines it is necessary to get the utmost power possible out of a given weight of copper and iron, and the heating limit is the only practical consideration. The efficiency of the machinery is secondary.

Plan C had been reduced to practice in this country by the late Mr. Van Depoele, who avoided the use of a fourth wire in the system by an ingenious method shown in Fig. 11. The regular commutator *A* is supplied with rotating brushes, B^2, B^3, in addition to the regular brushes *B*, B^1. It appears that as the rotating brushes revolve a simple alternating current flows through the end coils of the drill, while a unidirection pulsating current of one-half the freqency circulates in the middle coil.

The requirements of construction and service have thus far induced me to employ a rather low voltage in the operation of drills, our present practice being to use about 100 volts alternating upon the drill. I have employed several methods of operating drills from high voltage circuits.

Referring to Fig. 3, if the regular brushes B^2 B^3 be connected to a 500 volt circuit the armature will run as a motor, and if the rotating brushes *B*, B^1 be spaced by a suitable amount, less than 180 degrees, they will take off the pulsating current for the drill circuit at, say, 100 volts.

Another method is shown in Fig. 12, where a 1,000-volt alternating circuit is led from the prime generator *A* to the vicinity of the mine, where it passes through the primary of a converter *C*, in which the voltage is reduced to 100 volts. A small motor *M*, running in synchronism with the generator *A*, directs the alternate pulsations into the drill circuits.

Turning now to the drill construction, Fig. 13 shows the first form in which the percussion drill was put upon the market. This I call a type A machine. As appears in the sketch, the machine consists of a seven-inch boiler tube provided with a suitable mounting. Within the tube are two solenoids *B*, B^1, a rotating device and a cushion spring. Traveling through the coils is a two-inch plunger, *D*, the middle portion of which is of iron; the upper end is of brass and is rifled as shown to fit the rotating device; the lower end is also of brass and is enlarged at the end into a chuck to hold the bit. The three sections of the plunger are welded together. The weight of this plunger was 38 pounds. This machine was designed to make 600 blows per minute with a 3-inch to 4-inch stroke. The first of these machines to be put into a mine was that started in May, 1891, in the Black Bear mine at Gem, Idaho. This was, I believe, the first commercial electric percussion drill plant ever operated. During the next few months several other mines and quarries were equipped with these drills, with the general result that where the rock was not excessively hard the work was fairly satisfactory, but in extremely hard rock several defects developed. The brass portion of the plunger would crystallize and break a short distance above the chuck. Under the severe strain of continuous work in hard rock the coils would become so heated as to ground, and the spring connections between the cable and the coils would give out. The construction of these drill coils deserves special description. Fig. 14 shows a coil complete ready to be put into the drill. The coil is constructed as follows: Upon a brass spool, the body and heads of which are insulated with mica, is wound a bare copper wire of square section; this wire is insulated as it is wound with mica. The complete coil is wrapped with mica and a metal tube slipped over the whole and soldered to the coil heads, making the completed coil waterproof and heat proof, as it is insulated with mica alone, nothing but mica and metal being used in its construction. The trouble with our first coils was that they were soldered up with a comparatively soft solder, and when the coils got very hot this solder softened, the joints opened, and the oil and dirt getting in carbonized and developed a ground. As an example of the treatment these drills received I will state that while visiting one of our drill plants that was used for railroad grading on the Great Northern Railroad in Idaho I saw the men dump one of these drills bodily off from a flat car on to a dump of broken stone down which the drill rolled some 20 feet. I might add that this was one of our most successful plants, 18 foot holes being regularly drilled in granite rock. In view of the defects mentioned the design of the machine was altered, as shown in Fig. 15, which shows a type B machine. The plunger has been enlarged to 2¾ inches and is what I call the double magnet type. The forward part *D* is now made of steel, the rifled part D^2 is also of steel, and the connecting piece D^1 is of brass. This design gives a solid steel chuck and brings the brass part of the plunger within the drill body. The coils are now encased in boiler tube jackets braced up with hard spelter and are heated to a bright red in process of manufacture. The spring connections have been abandoned, and solid set screw connections now connect the cable to the drill. A switch is inserted in the cable near the drill. This machine seems to overcome the defects of the old drill and has thus far proved very satisfactory. This machine takes a stroke of about five inches and runs at about 380 blows per minute. This longer stroke is found more effective in keeping the hole free from mud.

Fig. 16 shows a still later type of drill that I have recently built and which promises to be much better than the others. The outside dimensions of this machine are about the same as the type A machines, but the plunger of this machine is a solid steel forging and 4 inches in diameter. No brass is used in the plunger, the metal being reduced in section where it passes through the front head. The ratchet device is similar to that used in air drills, and, in fact, the whole design of the machine quite closely follows the air drill construction. This machine takes a stroke of from 6½ to 7½ inches, and makes about 380 blows per minute; the plunger weighs 80 pounds.

Fig. 17 shows the cable connection and switch *A*, and the cable fuse box *B*, through which connection is made from the mains to the cable. A study of the operations of these machines presents many interesting features. In Fig. 18 is shown what I term an energy curve of the machine. This curve is obtained in a manner similar to an indicator card of a steam engine. Referring to Fig. 19, *A* is a cylinder mounted parallel to the drill rod. This cylinder is geared to the armature shaft in such a manner

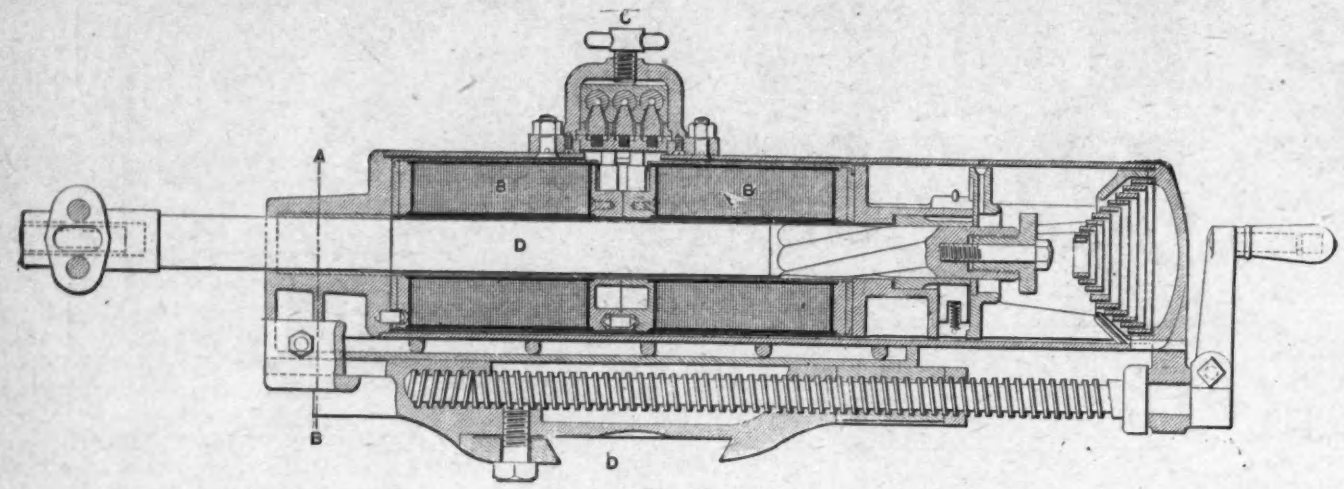
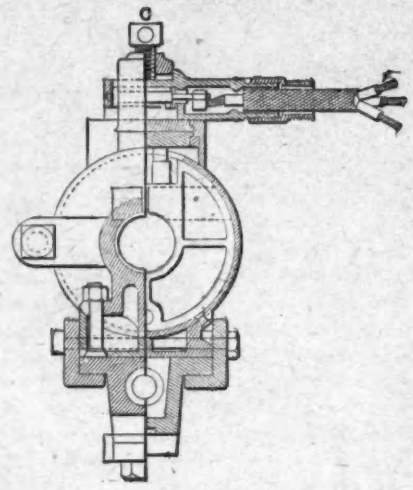


Fig. 13.



Section AB. Fig. 13A. Section CD.

Fig. 14.

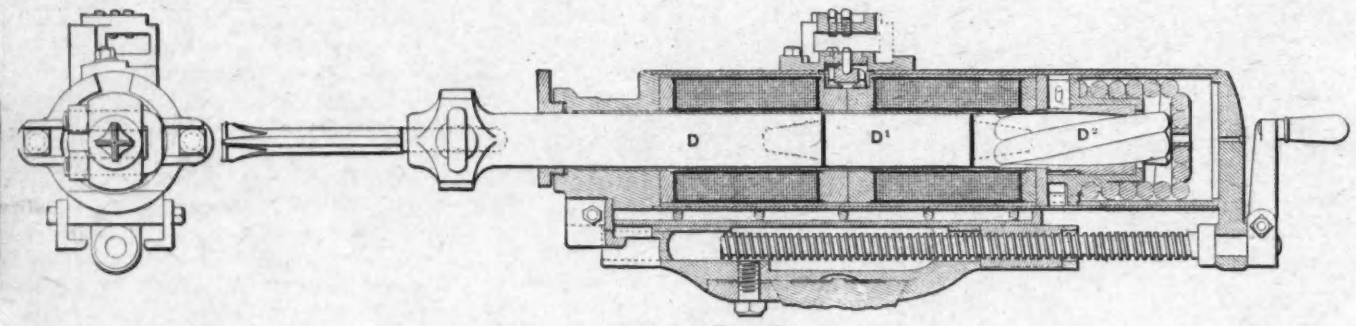


Fig. 15.

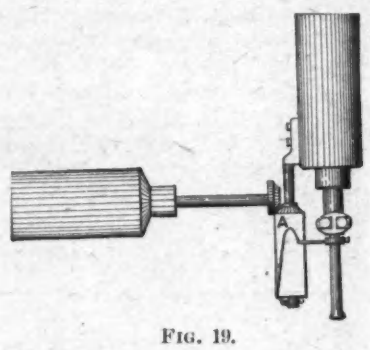


Fig. 19.

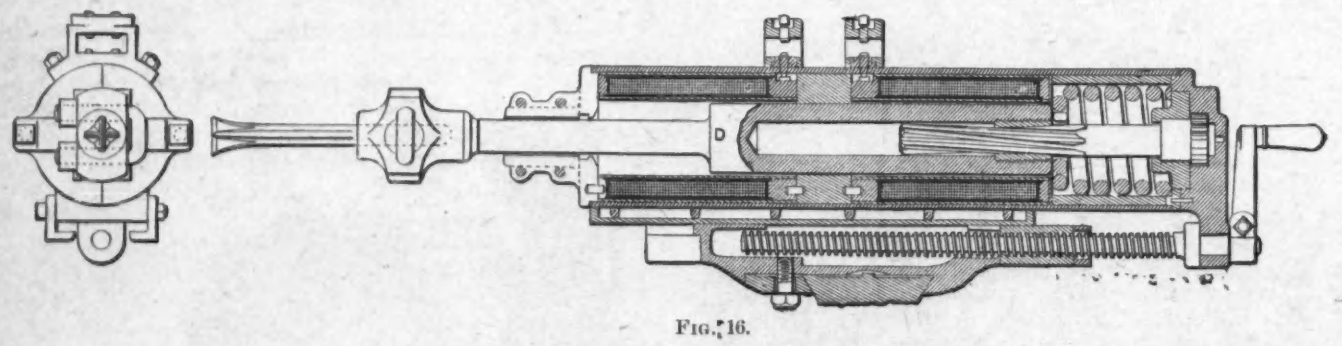


Fig. 16.

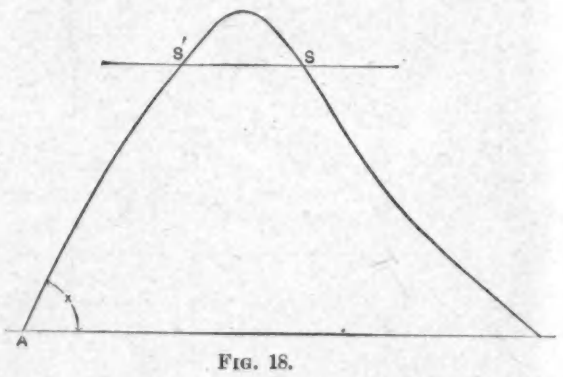


Fig. 18.

DIAGRAMS ILLUSTRATING THE ACTION OF THE PERCUSSION DRILL.

that it rotates in synchronism with it. A pencil carried by the drill rod rests upon the cylinder *A*; it appears that as the drill rod reciprocates and the cylinder *A* rotates, a curve will be traced by the pencil. Fig. 18 shows such a curve. The direction of motion of the paper being from left to right, it appears that the angle *X* of the curve at any point indicates the velocity of the plunger at the instant. *A* is the point where the plunger strikes the rock, and the sharp rebound is shown by the angle. The concave character of the curve *M* shows the backward acceleration of the plunger. The buffing spring is encountered at *S* and the angles at *S* and S^1 show that there is little loss in the spring. The angle *X* gives the final velocity of the plunger when it strikes the rock. A simple calculation gives the energy of the blow in foot pounds. This affords a good method of comparison between different machines and conditions. The general character of the curve reveals the general action of the forces during the stroke. The curve in Fig. 20, for example, shows that the drill rebounded sharply at *A* and then stood still for a considerable time at *B*, indicating that the stroke was too short for the power applied and the frequency of the stroke. On Fig. 21 we have shown the reverse conditions where the concave character of the curve at *B* indicates a loss of velocity and the length of the stroke is evidently too great for the power

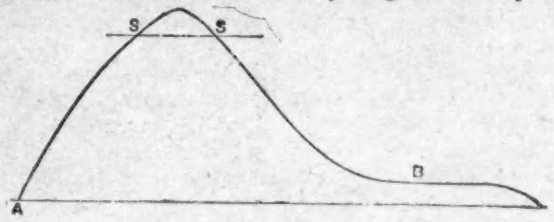


FIG. 20.

applied. Fig. 22 shows a curve taken on a type *A* drill with an 18-foot bit drilling downward in slate rock.

The energy of the blow being determined, it can then be decided whether the drill delivers the greater amount of energy upon the rock by a few long strokes or by a greater number of strokes.

Some other interesting curves are shown in Fig. 23. Curve *A* shows the voltage on the drill circuit, curve *B* and B^1 the current in the two coils. Curve *C* is the energy curve. The lines $E\ D^1$ indicate where the brushes make contact with the half ring.

The efficiency of the above machines compared with other forms of electro motors is, of course, low; but this factor is of comparatively little moment in percussion drill work. It is far more important that the machine should be able to endure the development of a large amount of power with a small weight than that it should be highly efficient. It would seem that the general mechanical design of these machines admits of greater durability and simplicity of construction than air drills, as there are no steam tight joints required, and a very great wear upon the moving parts does not reduce the effectiveness of the drill. The general flexibility of the electrical system and its peculiar adaptation to mining work are well recognized, but it has been urged that for drill work compressed air is a necessary motor for ventilation. A careful investigation of this matter reveals the fact that there is little or no weight in this objection. The instances are extremely rare where compressed air is relied upon for ventilation, and I have found few miners who considered this matter of importance.

Although the introduction of the percussion drill has

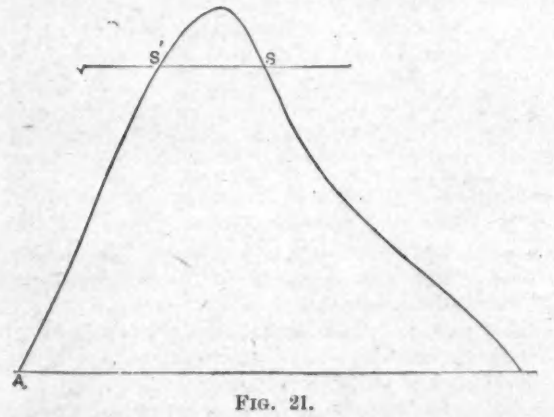


FIG. 21.

been attended with many difficulties, I believe that the obstacles have been so far overcome that the machine is today in thoroughly practical shape.

Electrical Engineering at Cornell University.

The annual report of President Charles Kendall Adams, of Cornell University, contains some interesting comments on the present condition of the Electrical Engineering Department of that institution. Regarding the work of Prof. E. L. Nichols, President Adams says:

"It is my pleasure to report that the Department of Physics has this year shown even more than its customary activity and prosperity. Owing to the fact that all students in engineering and architecture are required to take work in this important department, the laboratory has been crowded throughout the year. But the demands thus made upon the teaching force have not prevented the prosecution of advanced studies. No department in the university combines more successfully the work adapted to beginners in physics with that intended for students carrying on original research with a view to advanced degrees. That the facilities here offered are appreciated by the physicists of the country is evinced by the fact that graduates from 28 colleges and universities have been carrying on advanced work in this department during this present year. This extraordinary record is a testimony to the efficiency with which the department is administered, as well as to the excellence of the material equipment. The professor calls attention to the fact that the results of original investigations

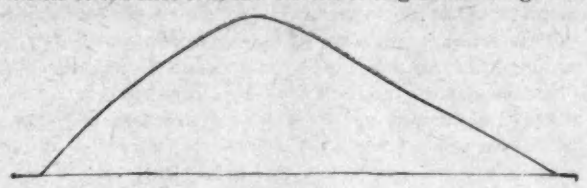


FIG. 22.

carried on in the laboratory since 1887 number articles by 34 different authors, and that these have been published in 25 journals and transactions in English, German, French and Italian."

Dr. Robt. H. Thurston, in his report to the president, comments thus on the work of the Electrical Engineering Department:

"The Department of Electrical Engineering, the second main division of the college, has continued its previously extraordinary growth, and now numbers fully one-half of all our students, its special work being performed in the junior and senior years, and the preparatory work being the same as in the regular course. The work in pure physics is taken in the Department of Physics of the university and that in distinctively electrical engineering, the application of the art of construction to the production and the installation of machinery, in this department of Sibley College.

"The instruction is given in lecture room and drawing room and includes the study of the design, construction and use of the various classes of electrical machinery, both with constant and alternating currents. The general in-

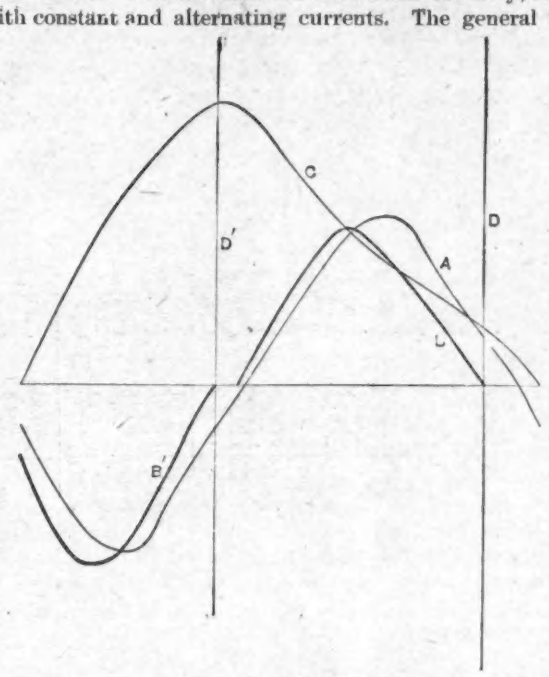


FIG. 23.

struction in the principles involved was given in the lecture room, the work of design was carried on in the drawing rooms and, in some instances, the designs were constructed in the shops. Courses of lectures have also been given by the head of this department, Professor Ryan, on the history and finance of the applications of electricity. Next year it is proposed to inaugurate a course of lectures and work in designing, relating to telephonic and telegraphic construction and practice. This has, in fact, long been proposed; but to make it successful it is necessary to depend, to a certain extent, upon the assistance of the great corporations controlling these operations in this country, and they have not been as much interested in their opportunities to do good work in this direction as have the makers of light and power machinery. The latter have always been both liberal and helpful. The former take no interest in the subject and are inclined to make the whole a matter of commerce, simply.

"The outcome of the year has been the preparation for graduation of an exceptionally large class, well prepared and likely to prove a credit to the university. The work of the heads of departments and their assistants, and even, in some cases, the more enterprising and able students, has also included considerable important research. The papers of Prof. Nichols in physics, and of Prof. Ryan, particularly, have been especially important and interesting, and are attracting attention throughout the world. It is through these lines of higher work, quite as much as through the success which has been so gratifying in the courses of instruction, that Cornell University has come to be regarded as the centre of this kind of professional work in this country. Both are important; but it may, perhaps, be questioned whether, after all, the promotion of research may not be the more important of the two. Instruction can be given anywhere; investigation can only be carried on where the right class of men can be brought together."

The number of students registered in electrical engineering in 1884 was 28; in 1835, 40; in 1886, 59; in 1887, 88; in 1888, 125; in 1889, 172; in 1890, 214, and in 1891, 250.

The number of graduates in 1886 from this department was 5; in 1887, 7; in 1888, 8; in 1889, 19; in 1890, 28; in 1891, 28, and in 1892, 46.

Secondary Batteries in Use at the Central Telegraph Office, London, for Telegraphic Purposes.*

BY W. H. PREECE, F. R. S.

In a paper entitled "The Use of Secondary Batteries in Telegraphy," communicated to the British Association at the meeting held in Montreal, in 1884, I gave an account of a series of experiments which had been carried on during the preceding twelve months, to determine the suitability of secondary batteries for telegraphic purposes. In the same paper, after giving a number of calculations as to the financial side of the question, I ventured to predict that secondary cells would soon be made the most economical of the sources of electrical energy for this purpose.

Since that time the use of secondary batteries has been extended, and for the past seven years they have been used to supply current to two large groups of circuits, one group

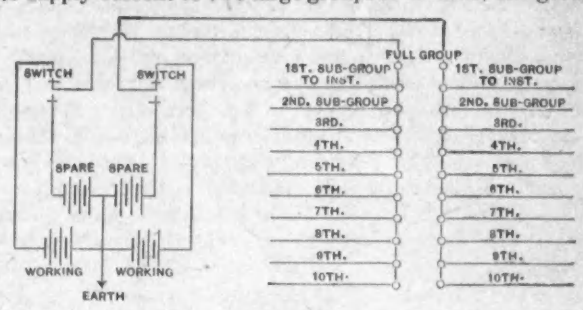


FIG. 1.

consisting of 110 single needles and the other of 100 Morse inkers and sounders.

To provide a ready means of replacing the battery in case of failure the leads from the working and reserve cells, which are placed in the basement, are first led up to the test board in the instrument room, and there joined to a switch, thence the leads are again led to a test board in the battery room, where the two groups are split up into sub groups of 10 circuits each. The connections are made in this manner for two reasons: first, for facilitating a change of faulty battery; and, second, to prevent a general stoppage of the whole group in the event of a short circuit at any of the instruments; the resistance of the leads between the instruments and the subdividing connections in the basement being sufficient to prevent more than three ampères being taken from the battery by any one of the instruments, even when a short circuit is on. To prevent any damage to the instruments or risk of fire fuses are placed in the battery leads at each instrument. The circuits on the groups mentioned are all metropolitan, and are all, approximately, of the same resistance, no equalizing resistances being therefore necessary. The current in each circuit ranges between 17 and 20 milliampères. The E. M. F. for the single needles is 20 volts—10 cells positive and 10 cells negative, with earth in the centre. For Morse working the E. M. F. is 18 volts. The connections are shown in Fig. 1.

In addition to these two groups, another set of 22 cells has been in use since 1889, supplying current for driving the motors of the Delany multiplex distributors. Each of these motors requires a current of about 0.12 ampère, and there are 10 of them at present driven from this source. Fuses are placed in the leads to each motor. There is no spare set for this work. A considerable extension of the accumu-

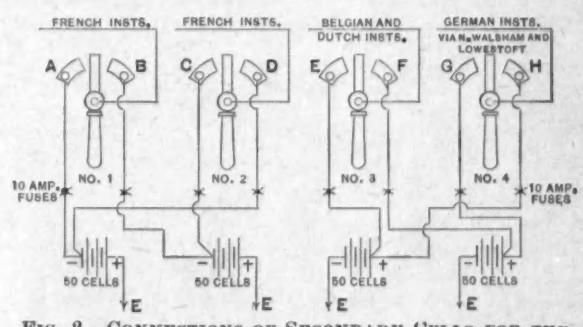


FIG. 2.—CONNECTIONS OF SECONDARY CELLS FOR THE CONTINENTAL GALLERY.

One hundred ohms resistance in each branch lead to French, Belgian and Dutch instruments; 1,000 ohms resistance in each branch lead to German instruments.

lator system has recently been made, advantage being taken of the transfer of all the Continental service to the General Post Office building in St. Martin's-le-Grand. This transfer was made on Oct. 17, 1891, and since that date the whole of the continental circuits have been operated by currents from secondary cells. There are 59 of these continental circuits, and as they are of various lengths, some requiring repeaters in England, while others go direct to the Continent, a somewhat different arrangement has been adopted. In addition to these varying conditions, it was found impossible to use the same polarity to all countries, the German, Dutch and Belgian lines taking positive, and the French negative. It was also necessary to provide an arrangement which would cause the stoppage of the minimum number of lines should a main fuse be burned or a battery fail.

The 59 lines are divided into four groups, but as the force required for these long lines is 100 volts it is evi-

*A paper read before the Edinburgh Meeting of the British Association, August, 1892.

dent that the risks of allowing a dangerously heavy current passing out from the instrument to line, should it make earth near the sending station, is increased. To provide against this, resistances of 100 ohms are placed in the battery leads at each instrument, so that it is absolutely impossible that more than one ampère can flow even with the earth on the line close up to the instrument. Independent 3-ampère fuses are also fitted to each instrument to prevent any damage to lines or instruments should the safety resistance be short-circuited. As it is sometimes necessary to put repeaters in on the English side of the cable on some lines which nominally work direct to the Continent, the resistance blocks on several of the instruments are wound to 1,000 ohms, and fitted with a switch which enables either 100 ohms or 1,000 ohms to be inserted in the battery circuit, and thus the current is kept constant. In addition to the independent 3-ampère fuses, main fuses to break at 10 ampères are placed on each group of circuits in the accumulator room.

The arrangement of the connections in use on the Continental lines is shown in Fig. 2. All the cells are kept well charged and the E. M. F. is not allowed to fall below 1.95 volts per cell. Where spare or reserve sets are provided the charging is carried on at any convenient time, and on those where no spare sets are in use the charging is done at night, when the minimum disturbance is caused by the slight increase of E. M. F., which is inseparable from simultaneous charging and working. Accumulators are also used for working the Paris telephone circuits. Their E. M. F. is so constant that they are found to be eminently adapted for the purpose.

Electro-Metallurgy.—IX.*

BY F. M. F. CAZIN.

SIXTH METHOD.

For the method of the electrolytical preparation of fuel to be used in metallurgical practice there is at this date no precedent in actual operation.

The questions involved in this method are essentially those relating to the conversion of energy from one of its modifications into another. And these questions demand both their theoretical and practical solutions.

The problem in total may be divided up into three different problems, namely:

1. The conversion ot any free energy available in nature into electrical energy.

2. The conversion of electrical energy into the energy of chemical affinity by the electrolytic disengagement of compounds into their components by the instrumentality of the electrical energy as obtained under conversion No. 1.

3. The conversion of the energy of chemical affinity obtained under conversion No. 2 into heat energy by the instrumentality of the reunion of the components previously disengaged (in conversion No. 2), viz., of combustion, or of combustion of one of the components with oxygen from the atmosphere.

Science has demonstrated the feasibility of all three of these conversions.

1. We know how to convert the free kinetic energy evolved by the gravitation of a current of water into controllable mechanical energy by the use of water-wheels. And we know how to convert this mechanical energy into electrical energy by the use of dynamos.

2. We also know how to convert the free electrical energy thus obtained into the energy of chemical affinity by electrolytically disuniting, decomposing many chemical compounds into their components.

3. And we possess a great amount of knowledge and practice in relation to the beneficiation of the heat produced by the unison of matter possessing the energy of chemical affinity.

It would therefore appear on the surface of the query, that the problem under the sixth method had been actually solved and that all that was yet required for actual successful practice consisted in a systematic grouping of the three actions as specified.

This conclusion seems to be favored by our present conviction as to the absolute permanence of energy as such. It is not surprising, therefore, that without actual test to support the assumption, a leading professional journal gives utterance to the expression:

"It is *certain* that electricity may be made to provide fuel in the literal sense of the word, and fuel, moreover, of a character eminently suited for metallurgical operations."

But, alas, if in theory this assumption is not without justification, actual practice in all three phases of the problem as a whole leaves its solution far behind in real results as against all theoretical prediction. If this were so only in the ordinary or normal degree or rate, as between perfect theory and imperfect practice, we would have good reason to be contented with our achievement so far. But the discrepancy in this case is so extraordinarily large that the practical result may be considered as failure rather than as success.

And yet the problem is of such immense importance, not to metallurgy alone, but to humanity at large, that the endeavors to solve this problem will never cease. And by a thorough understanding of all the conditions that are accessory thereto, a practical and successful solution will ultimately be found, under which the different conversions from modification to modification of energy will be so thoroughly subjected to our control, that not so considerable a part of energy at each conversion wanders in another direction than the one intended by us, and follows a channel of its own in the maintenance of that eternal equilibrium of all energies that is the supreme law of nature.

Practically the problem as it stands to-day is mainly one of insulation of all modifications of free energy with the same thoroughness that we strive at in the insulation of free electricity.

It is the second class of conversions, that these pages are mainly interested in, viz., the direct decomposition of chemical compounds into their components by electric energy, as the essential subject of electrolysis and electro-metallurgy.

The main compound from which, by electrolysis, combustible matter can be obtained is water, and the combustible positive matter that is obtained as a cathion is hydrogen, and hydrogen by all its chemical qualities is not less a metal than mercury or lithium is. And even physically it appears as a metal of a density of 0.62; this is heavier than lithium, when as cathion it alloys with palladium. And hydrogen, on account of its gaseous form under normal temperature, cannot be refused its rank as metal as long as on account of liquid form such quality is not refused to mercury. Therefore, I am justified to consider the electrolysis of hydrogen in the order of metals, and as a part of the electro-metallurgical action.

10. THE ELECTROLYTIC DECOMPOSITION OF SOLUBLE SALTS AND THEIR BEHAVIOR AS ELECTROLYTES.*

I. Metal salts are soluble in water with the following exceptions:

(1) The salts, in which some metal is the radical as well of the acid as of the base.

(2) Basic nitrate of bismuth and of lead.

(3) Sulphate of lime, of baryta, of strontium and of lead.

(4) Acetate of silver and of mercury.

(5) Basic carbonates, phosphates, borates, silicates, arsenates, unless the base be an alkali.

II. Metal salts are formed either

(1) Directly, by the acid combining with a basic compound of metal and negative matter, or

(2) Indirectly, by water, steam or vapor present in the acid being decomposed, oxygen of the water forming with the metal present a basic compound, which again with the acid forms the metallic salt.

The latter action is the action of an active cell, as can be readily shown by the fact that absolutely chemically pure metals do not dissolve or form salts under these conditions, while the presence of even the smallest quantity of another metal of a comparatively different electric nature produces the reaction specified under II. (2), by which the energy of chemical affinity is modified into electro-galvanic energy.

When the two metals present are immersed in an acidulated solution of a metal salt, then the dissolving metal acquires positive electricity, and the other metal acquires negative electricity, and the positive element (metal) of the base of the salt present in the electrolyte becoming disunited from the negative element, with which it formed the base (such negative matter uniting with the dissolving anode), gathers (directly or indirectly) at the negative pole (metal).

And unless the stored energy of chemical affinity is prevented from becoming active by the removal of one of the elements possessing such affinity, or unless the electric energy producing the disuniting electrolytic reaction remains in excess of the energy of chemical affinity that becomes stored in the passive cell, the electrolytic reaction ceases, and when this free energy of chemical affinity is no longer opposed by a stronger or equal electric energy, but is free to form a current in the re-establishing of electric equilibrium or neutrality, then the former passive cell becomes an active cell, and in such cases where electric neutralization is prevented, it becomes a storage of electric energy (storage battery).*

If the preceding explanation is thoroughly understood, all questions of practical electrolysis can thereby be decided.

For resistance created in the passive cell by free energy of chemical affinity present the name "polarization" is improperly applied, notwithstanding the same word has an older and clearer meaning applied to the magnetization of matter as such.

Properly the names "electrolytic reversal of action" or simple "cell reversal" or "reversal" covers the case and applies to the reversal of action from passive to active cell and vice versa, allowing the use of "active reversal," or "passive reversal," according to the result.

Active reversal is essentially fostered by the cathion not having the anode as the result of some disturbing influence, and protecting the anode against further contact with the electrolyte and by itself re-entering into a compound and thus creating the reversal from passive to active cell action.

If for some reason or other the electric pressure produced in the active cell (or dynamo) lessens temporarily below the requirement in the passive cell, active reversal of current is the consequence. With electrodynamic producers such reversal of direction of current, unless prevented by some regulating influence, is apt to become permanent, in consequence of which permanent reversal the electrolytic action in cell or bath is changed in character and quality, resulting in complete reunion of the components previously disengaged to the compound from which they originated.

As a preventive of such occurrence dynamo electric producers are provided with an apparatus called a "current breaker," by which the produced current when at the point of reversal is entirely cut off, thus protecting the poles of the electromagnets against reversal, allowing the continued run or the new start of the dynamo under normal polarization.

Regardless of quantity of metal disengaged, the electrical pressure consumed in any electrolytic reaction must meet the following requirements:

(a1) The conditional electric pressure for the intended disunion $= R(_1) = 2\frac{c\,N}{c\,P}$ volts.

(a 2) The electric pressure counteracting modification of volume as between compounds and components.

(b) The electric pressure counteracting the energy of chemical affinity that is stored in the passive cell in the decomposed components.

(c) The pressure overcoming the resistance offered by the electrolyte as conductor of the active current.

Of the total sum of pressure required,

$$\text{as } R(_s) = a\,1 + a_2\,b + c$$

we know so far only the one value for

$$a\,1 = R(_1) = 2\frac{c\,N}{c\,P}\text{ volts},$$

and therefore have to yet determine the values for $a\,2 = R(a\,1)$, $b = R(_s)$ and for $c = R(_4)$.

I have to refer to the following table and to some preceding discussion in regard to value $a\,2$ and its determination. As a matter of more general scientific interest, the pages of a journal devoted to a special branch offer not the proper opportunity for a thorough discussion; but for the studious, the table as such, with its figures and their relation to one another, illustrates the subject intelligently. The values for $h\,t(_1)$, from which all others are calculated, were experimentally established by the use of the calorimeter, shown on page 385, third column of vol. XIX., p. 23, of this journal.

TABLE OF CALORIC VALUE ILLUSTRATING THE CALORIC EFFECT OF MODIFICATION OF VOLUMES BETWEEN COMPOUNDS AND COMPONENTS.

Positive matter, of which 1 kilogramme enters the compound.	Proportionate weight of + and − matter entering the compound. $AWPcP.$	$+AWN.cN.$	Compound formed $\frac{AW}{P.cP+AWN.cN.}$	Kilogramme-calories produced by combustion of 1 kilogramme of positive matter $= ht(^1)\frac{AWN.cN.}{AWP.cP}$	Kilogramme-calories produced by the combustion of $AWP.cP$ kilogrammes of positive matter $= Ht = ht(_1)\frac{AWP.}{AWN\times cN.}$ $cP = ht\times AWN\times cN$	Coefficient of $ht(_1)$ to reduce the effect in calories to that of 1 kilogramme of negative matter $(= ht)$ $= \frac{AWP\times cP.}{AWN\times cN}$	Coefficient to reduce $ht(_1)$ to the combustion of 1 electrolytic equivalent $(= \frac{1}{2}ht)$ $= \frac{AWP\times cP.}{2\times AWN\times cN.}$	Kilogramme calories produced by the combustion with 1 kilogramme of negative matter $= ht(_1)\frac{AWP\times cP}{AWN\times cN}$ $= \frac{Ht}{AWN.cN.}$	The coefficient of $2\frac{c\,N}{c\,P}$ relating to the value a_2 by 3,050 calories relating to unmodified volumes $= cV.$
H.....	2.	15.96	H_2O...	34,462	68,924	$2 + 15.96 = \frac{1}{8}$	$\frac{1}{16}$	4,307.75	1.4217
C.....	11.97	15.96	CO.....	2,473	29,612	$11.97 + 15.96 = \frac{3}{4}$	$\frac{3}{8}$	1,854.75	0.6121
CO.....	$\frac{3}{7}\times$ 11.97	$\frac{3}{7}\times$ 15.96	CO_2.....	5,605	28,745	$11.97 + 15.96 = \frac{3}{4}$	$\frac{3}{8}$	4,205.25	1.2888
C.....	11.97	31.92	CO_2.....	8,080	96,716	$11.97 + 31.92 = \frac{3}{8}$	$\frac{3}{16}$	3,030	1.0000
Ag	107.60	7.98	$\frac{1}{2}(Ag_2O)$..	57	6,133	$108 + 8 = \frac{27}{2}$	$\frac{27}{4}$	769.50	0.2539
Pb.....	206.40	15.96	Pb O...	263	54,902	$206.4 + 15.96 = 13$	26	3,458	1.1411
Cu.....	63.20	15.96	Cu O	604	38,173	$63.2 + 15.96 = 4$	8	4,832	1.4990
Cu.....	63.20	7.98	$\frac{1}{2}[Cu_2O]$..	272	17,190	$63.2 + 7.98 = 8$	16	2,496	0.8237
Sn.....	117 50	31.92	Sn O_2..	1,167	137,122	$117.5 + 31.92 = \frac{11}{4}$	$\frac{11}{8}$	4,279	1.3132
SnO....	$\frac{11}{14}\times$ 117.50	$\frac{11}{14}\times$ 15.96	Sn O_2..	592	54,655	$117.5 + 15.98 = \frac{23}{4}$	$\frac{23}{8}$	4,341	1.4326
Zn	64.90	15.96	Zn O....	1,291	83,786	$64.90 + 15.96 = 4$	8	5,164	1.7042
Fe.....	55.90	15.96	Fe O....	1,359	75,968	$55.90 + 15.96 = \frac{7}{2}$	7	4,753	1.5686
Fe. .	55.90	23.94	$\frac{1}{3}[Fe_2O_3]$.	1,772	99,055	$55.9 + 23.94 = \frac{7}{3}$	$\frac{7}{6}$	4,135	1.3646
Fe	55 90	21.28	$\frac{1}{3}[Fe_3O_4]$.	1,575	88,042	$55.9 + 21.28 = \frac{21}{8}$	$\frac{21}{16}$	4,135	1.3646
S	31.98	31.92	SO_2... .	2,221	71,028	$31.98 + 31.92 = 1$	1	2,221	0.7330

*For the eighth section of this article see THE ELECTRICAL WORLD of Aug. 6, 1892.

*[The following corrections should be made in the preceding parts of this series:

On p. 310, Vol. XIX., No. 9, sixth line, read: "7. Equal weights of the same negative element, and equivalent weights of different negative elements."

On p. 60, Vol. XX., No. 4, in fourth column of table, correct the heading to read: "Division of AWP to produce the electrochemical equivalent proportionate to $\frac{1}{2}O = +\frac{2\,c\,N}{c\,P}$, $= \times\frac{c\,P}{2\,c\,N}$ as coefficient," and correct, for "Iron," "$2\frac{2}{3}$."

On p. 61, Vol. XX., No. 4, first column, fourth line, "mm." in place of "mgm."

On p. 75, Vol. XX., fourth column, eighth line from the last, read: "Expresses the electrical pressure, on which is depending the electrolytic action," and add, at the end of the sixth line from end, "and regardless of resistance by the electrolyte as conductor."

On p. 75, second column, Vol. XX., No. 5, near the bottom, read: "$100{,}000\,Q\times 2\frac{c\,N}{c\,P} = AWP$"; and on same page, first column, near the bottom line, read, "100,000 coulombs, in place of 10,000 coulombs".]

*That the difference in quantity of positive matter entering and leaving the compound present in the electrolyte also measures active and passive electric energy cannot be doubted, but the precise relations are as yet not determined upon.

The value for the counter action $b\,(=R\,(_3))$ is of the same nature as the value $R\,(_1)$ this is: It is as $R\,(_1) = 2\frac{c\,N}{c\,S} \times$ $c\,V$ is measured both by the proportionate quantity of negative matter present in the compound, to the positive matter present and by the unification of volume as expressed by $c\,V$. It therefore can never be higher than the value $a + a\,(_2) = (R\,(_1)$ itself. But, as long as the value a in electric pressure is conditional to the electrolytic reaction itself, unless there is in excess thereof sufficient to cover the value b, the electrolytic reaction desired itself will cease, while a surplus equal to a or a total electric pressure equal to $2\,a = 2R\,(_1)$ will overcome all resistance that may or can be produced by the energy of chemical affinity in the disengaged components (ions) that remain in the cell.

The sole effective remedy against such reversing action consists in the permanent removal of one of the disengaged components (ions), which removal is accomplished by its recombination being provided for, and this may be effected either:

(*a*) In the passive cell itself, resulting in the production of electric energy therein and in the proportionate reduction of pressure required to the total reaction as such, or

(*b*) Outside of the passive cell by circulation of the electrolyte, if it contains the disengaged component either in a free or compound state. And then the previously disengaged component (anion) may be utilized outside of the passive cell as a chemical solvent in overcoming in part the chemical affinity that binds the coveted metal in its natural occurrence.

And reference is here made to those electro-metallurgical methods, already specified, in which such solution carrying the union is taken advantage of, by means of a circulating electrolyte.

As in all practical cases a surplus of electrical pressure must be provided for, and then the question arises, whether this pressure goes to waste, if polarization or reversal of action does not consume it.

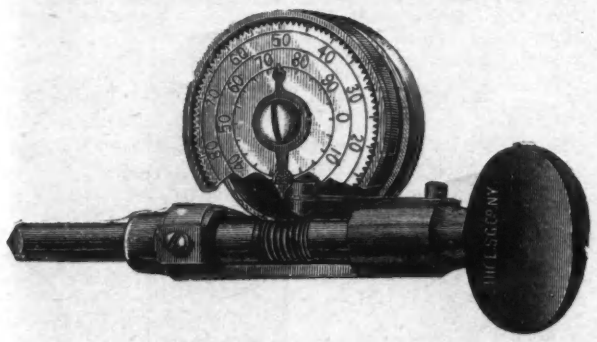
The law of permanent conservation of energy gives answer to this question to the effect that this surplus of electric pressure must either be consumed by increasing (not the quality of action, but) its quantity, or must leave the passive cell again, and if not employed by passive cells being set in series, must either cause a constant increase of action. pressure in the current as such, or must act as a brake or moderator in the active cell or producer of electric energy.

This question thus raised relating to the function of surplus electric pressure as against such as is conditional to the electrolytic reaction as such demands specific discussion, which is reserved to another chapter, as also the discussion of the specific resistance offered by the electrolytes as conductors, to overcome which the value $c = R(_4)$ is additionally required in the functionary electric pressure required for the entire electric action.

The Gem Indicator.

The accompanying cut illustrates a very neat and useful pocket instrument for electricians and others. The Gem Double Speed Alarm Bell Indicator implies the character of the device.

It is a combination of a speed indicator and alarm bell.



THE GEM INDICATOR.

It is nickel plated and in size is only $3\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{3}{4}$ inches and may be easily carried in the vest pocket.

To use the Gem indicator, apply the engaging point to the shaft of the machine being tested, and, with watch in hand, wait until the bell rings. Upon the ringing of the bell begin to observe the time and continue as long as may be desired, it being simply necessary to count the strokes of the bell thereafter; each stroke indicating 100 revolutions. Upon expiration of the time limit remove the indicator and add any fraction of 100 that may be shown upon the dial to the full hundreds previously counted by bell strokes.

The handiness of this instrument will be readily appreciated by engineers, lathemen, dynamo tenders, and those who have to do with machinery and engines of all kinds. Messrs. The E. S. Greeley & Co., 5 & 7 Dey street, New York, are placing this indicator on the market.

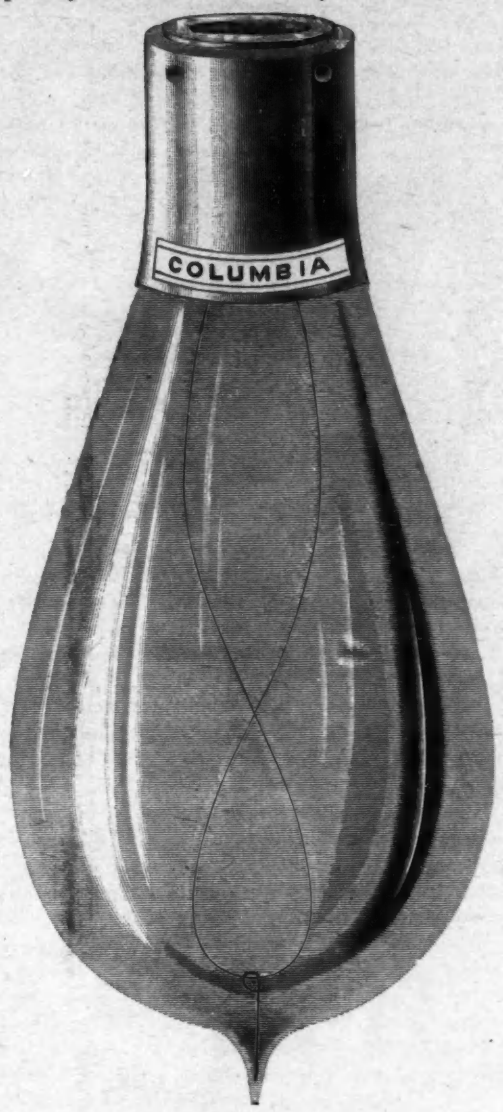
Compensated Galvanometer of Constant Sensitiveness.

In a tangent form of galvanometer described by G. Grassi in a recent number of *Bieblätter*, besides the ordinary vertical coil in the meridian, a second vertical coil in the plane at right angles to the first is traversed by the current in a direction such that it opposes the direction of the earth's force. If a_1 and a_2 are the distances of the centre of the needle from the peripheries of the two coils respectively, n_1 and n_2, r_1 and r_2 the number of turns and the radii of the coils, α the deflection and H the horizontal component, then C is approximately $= (H\,r_1\,\alpha) + 2\,\pi\,(1 \times A \tan \alpha)$, where $A = n_2\,r_1 + n_1\,r_2$.

The Columbia Special Railway Lamp.

The accompanying cut represents the Columbia special railway lamp, manufactured by the Columbia Incandescent Lamp Company, of St. Louis, Mo.

Great care is taken in the manufacture of this lamp, and it is specially measured for uniformity of current, so that the

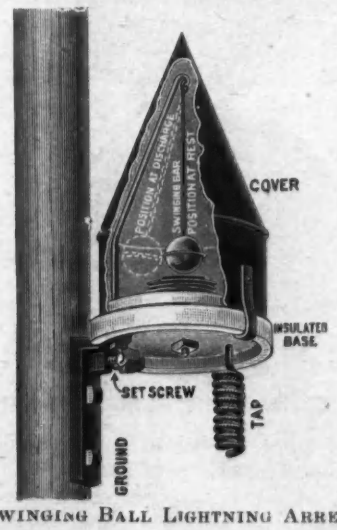


THE COLUMBIA RAILWAY LAMP.

lighting throughout each car, where a series of Columbia lamps are used, will be entirely uniform. A great many lamps have been made for street railway use in which the carbons have been simply hooked at the bottom, but there has been no attention given to the fact that lamps for use in street railway circuits must be uniform as to current consumed if the best results are to be obtained. The lamps are efficient and will not blacken, and give a very satisfactory life. They are mechanically perfect, it is claimed, and all are guaranteed to make a perfect contact in the socket. They are used in a great many of the street railways throughout the United States, where they are reported to be giving entire satisfaction.

The Swinging Ball Lightning Arrester.

The accompanying illustration shows a new type of the swinging ball lightning arrester manufactured by Messrs. Truax & Vail, of New York City. The original type of this apparatus was illustrated in THE ELECTRICAL WORLD of June 20, 1891. The present type is of a somewhat modified form, although the general principle upon which the action of the arrester depends is the same in this as in the former



THE SWINGING BALL LIGHTNING ARRESTER.

style. A static charge from the line passes to earth through the pendulum arm, across the space between the ball or bob and the ground plate below it, and in close proximity to it. If there is a tendency for the dynamo current to bridge over this space, a heavy arc is formed between the pendulum ball and the plate below, and the sudden expansion of the air causes the pendulum to swing aside, thus breaking the arc. The arm then swings back into place, and the arrester is again ready for work.

High Speed Electric Traction in Germany.

Negotiations are pending between M. Van den Kerchhove of Ghent and the Belgian government regarding the construction of a high speed electric railway between Antwerp and Brussels. The distance between the two cities is 27 miles by the State Railway, and is covered by the fast trains in 48 to 58 minutes, according to whether stops are made at Schaerbeck, Vilvorde or Mecheln. With electricity as the motive power the journey is to be made in 20 minutes, namely, at the rate of 66 miles an hour. The scheme is favorably received all over the country, and two ministers of the government have intimated their approval of the same to its originator, although even heavier demands would be made upon the State finances than would be necessary for the construction of the new line from Mecheln to the southern part of Antwerp. In this growing quarter of the city, where, as will be remembered, the Universal Exposition was held in 1885 and where in 1894 or 1895 another international exposition is to take place, the proposed electric railway might simply be continued from the central railway station in the eastern portion of the city. Everything depends now upon getting the better of the delay on the part of the Antwerp town council, whose purse would, however, scarcely have to suffer at all. The petition entered to the effect that the government should examine into M. Van den Kerchhove's scheme, and then defer the commencement of the works decided upon in regard to the new section of railway to connect Mecheln with the southern quarter of Antwerp for a few months at least, must, of course, emanate from the Antwerp municipal authorities. The southern quarter of the city would be better served by a through line to Brussels than a branch line from Mecheln. The State Railway might do away with its fast trains altogether on the already overtaxed existing line; as the electric trains would be dispatched in all the different directions every 10 minutes, the service would amply meet the traffic between the two cities, and there would then only remain the extra local traffic to be dealt with in the same way as before. The proposed electric road is to run straight, as a main line, and this could be carried out all the more easily since the most serious grade is only one-half per cent. The trains would consist of one or two coaches having prow-shaped ends, in order to reduce the air resistance. The guard would have his place in a separate compartment in the front of the train, whence he could control the motors located on the car axles, the current being conveyed to them by an overhead conductor. The coaches would be lightly built, and each have accommodation for 60 passengers; they would be capable of being coupled to ordinary trains or of being employed to draw ordinary coaches.

Foreign Exhibits at the World's Fair.

Up to the present time no very active steps have been taken by foreign exhibitors in regard to an electrical display at the World's Columbian Exposition.

In France the Committee on Electricity is endeavoring to obtain through the Minister of Commerce an appropriation of 100,000 francs, so that it may be assured that the Administration of Telegraphs will take part in the exposition. This is regarded as necessary in order that there may be some nucleus about which the other exhibitors may form. There seems to be little commercial interest, and it is thought that a patriotic motive alone can influence French manufacturers to make a successful exhibit.

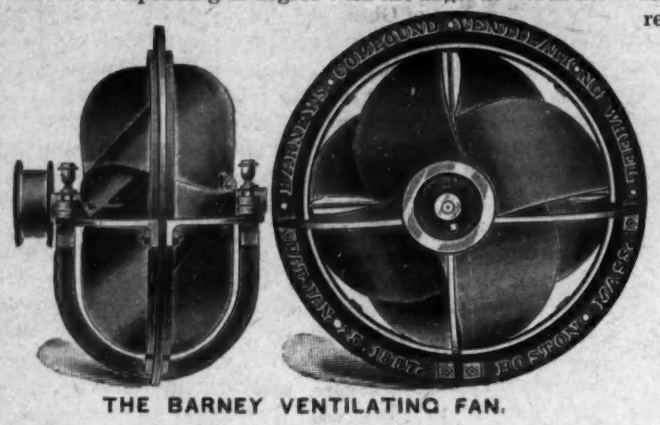
In England more progress has been made, but an exhibit which would do credit to that country has not yet been pledged. At a recent meeting of the Electrical Trade Section of the London Chamber of Commerce, Mr. W. H. Preece said that out of 27,000 square feet allotted for English electrical exhibits only 5,000 had yet been taken. On this 5,000 square feet, however, some very good displays were to be made, as the following official list indicates:

Electric batteries, primary and secondary, the Epstein Electric Accumulator Company, Limited, 210 square feet; machines and appliances for producing electrical currents by mechanical power, dynamical electricity, the Electric Construction Company, Limited, 1,088 square feet; C. A. Parsons & Co., 200 square feet; transmission and regulation of the electrical current, Robert Ewing, 25 square feet; electric motors, S. Z. de Ferranti, 450 square feet; application of electric motors, J. G. Lorrain, 110 square feet; lighting by electricity, General Electric Company, Limited, 400 square feet; electro-metallurgy and electro-chemistry, Elmore's American and Canadian Patent Copper Depositing Company, Limited, 270 square feet; the London Metallurgical Company, Limited, 1,600 square feet; electric telegraph and electric signals, G. L. Anders & Kottgen, 50 square feet; the Phonopore Syndicate, Limited, 196 square feet; the telegraph and its appliances—phonographs, Collier Audible Telephone Company, 100 square feet; Homacoustic Speaking Tube Company, 40 square feet.

Mr. Preece suggested that a number of the prominent English manufacturers should co-operate, pledge a certain sum and fit up a suite of rooms in such a way as to give an adequate idea of the progress made in the application of electricity to decorative work, lighting and other household purposes. With this end in view the Chamber is to issue a circular to the various manufacturers and engineering firms,

The Barney Ventilating Fan.

The Barney compound ventilating wheel is a scoop wheel and constructed in two sections, each section consisting of a series of blades mounted upon hubs at an angle to the axis with the inner straight edge of each blade lying in the plane of the rear face of the section, and the outer curved edges forming the front face of the section. These two sections are united upon a common shaft with the planes of their inner faces abutting, and the outer edge of each blade secured to a common peripheral central ring. The concave inner surfaces of each two, and alternate opposite front and rear blades forming channels for the passage of air through the wheels at an angle to the axis of the wheel corresponding in degree with the angle at which the



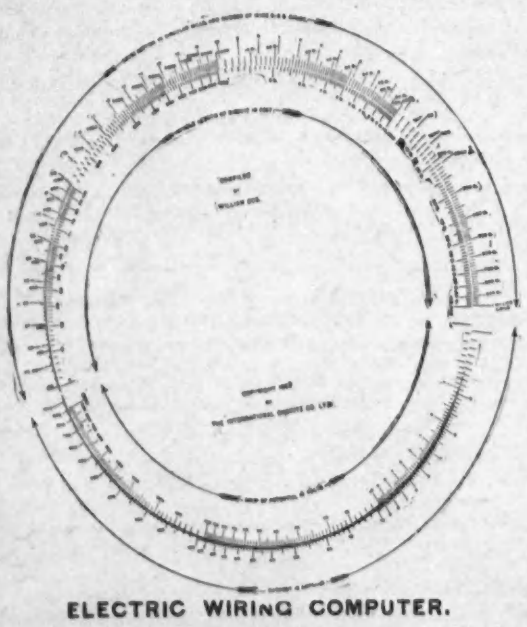
THE BARNEY VENTILATING FAN.

blades cross the shaft. The compound wheel in central cross section presents an elliptical outline. When this compound wheel is rotated as the blades on the front and rear faces of the wheel flare in opposite directions those on the front or feeding face will draw the air in to the wheel, while the blades on the rear or discharging face will beat away the surrounding air and form a vacuum at the rear of the wheel. Another new principle of this wheel is the peculiar form and construction of the blade. It will be seen by reference to the cuts that the blade in application is reversed from the form in general use, that is, the widest part of the blade is at the centre of the wheel where the speed is the slowest and the narrowest part at the periphery, where it is the fastest, and as this wheel feeds from every angle even at right angles to its shaft the air is drawn into it in a more even volume, and when under pressure the air is retained and does not escape back through the centre. This is especially valuable in blowing or exhausting air under pressure caused by friction, such as drying wool, forcing the air through long ducts and similar work. The wheel is constructed with a view to service and is made of the best material obtainable, is carefully adjusted, balanced and put together and fully guaranteed to do the work that it is recommended for. These wheels are manufactured by the Barney Ventilating Fan Company, 74 Pearl street, Boston, Mass.

A New Electric Wiring Computer.

The application of scientific principles to practical uses involves the frequent use of formulæ, and in no branch is this perhaps more exemplified than in the case of electricity.

The accompanying illustration shows the general plan, although it does not bring out the detail of, a wiring computer arranged by Mr. William Cox, by means of which the sectional area and the gauge number of wire suitable for lighting and other purposes is obtained. It consists of a suitable foundation plate, with a revolving circular disc



ELECTRIC WIRING COMPUTER.

about eight inches in diameter, both graduated in accordance with the factors of the formula whose solution it gives. This is the well known one

$$C.\ M. = \frac{l\,c\,10.8}{V}$$

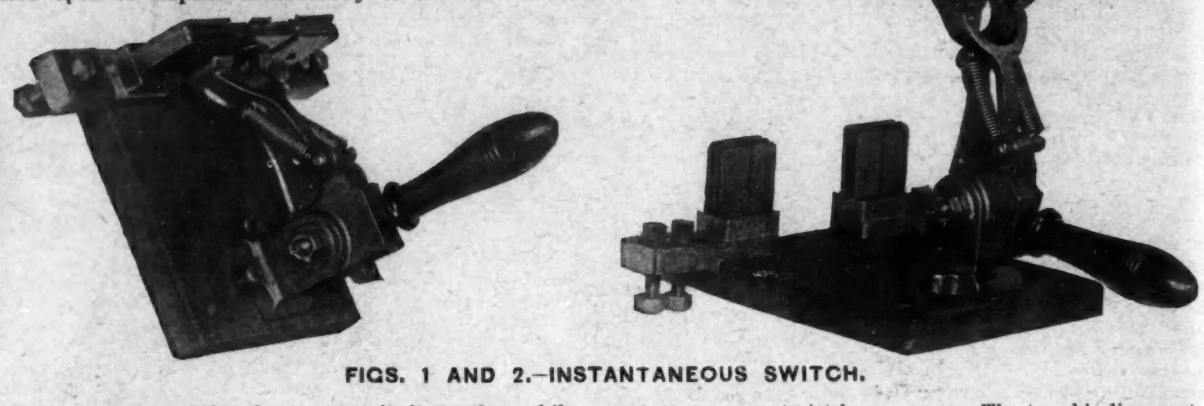
in which l represents the whole length of circuit in feet, c the current in ampères, V the drop of potential in volts and $C.\ M.$ the sectional area of suitable wire in circular mils.

The following example will illustrate the method of using this computer. Assume a case in which 76 feet is the whole length of circuit, 10 ampères the current and 2 volts the loss of potential; turn the disc round until the division representing 2 volts is opposite and coincides with the one representing 10 ampères. We shall now find on the outer upper scale 4,100 circular mils, which corresponds to No. 14 wire, B. & S. gauge. This is therefore to be taken as the number of the wire suited to the circumstances.

Mr. Cox has sold his invention to the International Okonite Company, Limited, of 13 Park row, New York City.

Instantaneous Switches.

The need of an effective instantaneous switch for use on railway and high-tension circuits, and one which can be relied upon to respond immediately to the desire of the station operator, and break the circuit instantly, while avoiding the dangerous and costly arc, has been long felt. Many experiments have been tried but have not proved entirely satisfactory.

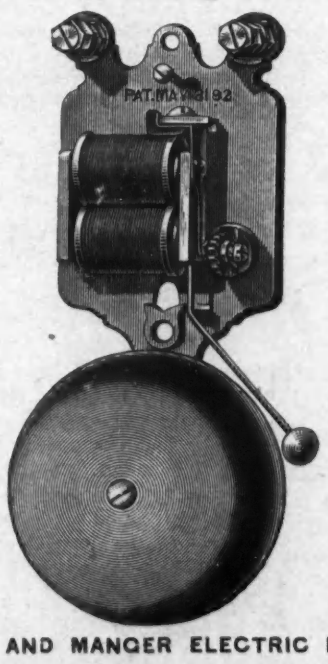


FIGS. 1 AND 2.—INSTANTANEOUS SWITCH.

The Cross Bar Instantaneous Switch, the invention of the General Electric Company, is the latest high voltage instantaneous switch. As its name indicates, it is a switch having its contact blade at right angles to the actuating lever. The terminal clips are placed opposite each other, but widely separated, and close the circuit as soon as the cross bar simultaneously enters both clips. This cross bar is loosely supported in the jaws of the lever by two steel pins, and a small steel spring serves to press the bar against the lever so that it will enter the clips truly and make full and easy contact with both inside faces of the clips. Practical use has shown that this flexible method of mounting the cross bar increases the durability of the switch, the alignment of the parts being rendered less liable to destruction by violent or careless handling. The snap or instantaneous action of the switch is obtained by means of two strong spiral springs, which are attached both to the handle and the lever. The movement downward of the handle distends the springs to that point of tension which compels the obedience of the lever, and the cross bar flies out from the clips, breaking the circuit at two points, and reducing the possibility of arcing to a minimum. When the switch is fully opened a catch spring retains it in position, and an accidental closing of the circuit is rendered impossible; this small spring also serves to give a snap action to the switch when the circuit is made. The smaller sizes have the cross bar in a single piece; those of larger capacity are provided with a double parallel bar, as shown in the cut.

The Huebel & Manger Electric Bell.

An improved form of electric bell, which is shown in the accompanying cuts, has been patented and placed upon the market by Messrs. Huebel & Manger, manufacturers of electric and brass goods, 286 to 290 Graham street, Brooklyn, N. Y. It is neatly finished, and the workmanship is excellent. All of the parts are plated, the core and armature being copperplated to prevent sticking. To remove the cover, it is only necessary to loosen the cover screw, when it can be readily slipped off. Recesses are provided on the bottom for bringing wires through when it may be desirable.



HUEBEL AND MANGER ELECTRIC BELL.

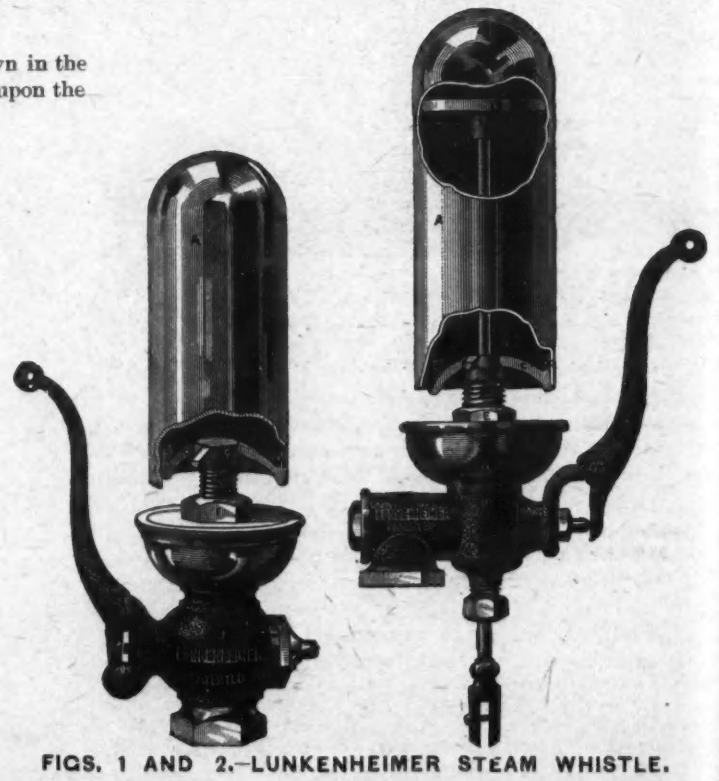
The main feature of the bell, however, is the contact post, which is so constructed that it cannot turn. Electric bells frequently become inoperative because the insulating bushings between the post and the base shrink, thereby loosening the connection of the post to the base so that the post, on account of the continued vibrations, will turn to one side and no longer present the platinized end of the screw to the action of the contact spring. In this bell the contact post is made of a strip of metal bent in U form, and its square base sinks into a recess formed in a raised boss on the base plate. The groove in this boss is slightly larger than the bottom of the post so as to admit a layer of insulation. The post is held by a fastening screw from underneath, as usual. It is thus seen that it is impossible for this post to turn or twist in any way. The two binding posts are constructed in a somewhat similar way, so that they will also remain rigidly in place.

Electric Launches for the World's Fair.

The contract for furnishing and operating a fleet of electric launches for carrying passengers on the lagoons in Jackson Park during the World's Fair has finally been awarded to the Electric Launch and Navigation Company of New York. The company will be required to build about forty launches, which will run through the lagoons and canals inside the park, there being about twelve landings during the round trip. The launch which took part in the competitive trials, and which represents the type to be employed, was illustrated and described in The Electrical World of June 11 and 18, 1892, and made a very excellent showing, indicating that launches operated by electricity are entirely practicable. The Exposition Company is to receive 33⅓ per cent. of the gross receipts.

The Lunkenheimer Steam Whistle.

The illustrations herewith show a new steam whistle. As will be seen by Fig. 1, the central stem is done away with, and instead of the usual square top with acorn, it is dome-shaped. The bell or dome is securely fastened at its lower end to a three-armed prong or spider, the stem of which is threaded to admit of being screwed into the base and there held secure by a jam nut. Owing to this construction the lower edge of the bell is always exactly in line with the slot in the base through which the steam escapes, insuring best results and a perfectly clear and loud tone. The bell can be raised and lowered to suit the steam pressure by screwing it up or down, and when properly set is fastened by the jam nut. It has been proved by practical tests that the prongs to which the bell is fastened do not in any way interfere with the volume or quality of the sound.



FIGS. 1 AND 2.—LUNKENHEIMER STEAM WHISTLE.

Referring to Fig. 2, this whistle, known as a combination or fire alarm whistle, is provided with a piston that can be moved up or down within the bell or tube, thus changing the interior length of the same and consequently also the sound of the whistle. When the piston is not operated the whistle gives but one sound like any ordinary one, but

when pulled up or down a series of bowling, penetrating sounds is produced. When placed above the roof of a building an extension rod must be attached to the piston and a rope or wire to the whistle valve lever. These whistles are claimed to have an important advantage over the old style with central stem, for, being securely fastened at their lower edge, it is impossible for the tubes to crack.

These whistles are patented and manufactured by the Lunkenheimer Brass Manufacturing Company, of Cincinnati, O.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK AND BOSTON, Aug. 6, 1892.

New York General Financial Market.—The week has been an active and satisfactory one to holders of industrial stocks. As we have predicted from time to time in this column, the industrial boom was the first one to strike the street, being manifest quite markedly in American Cotton Oil, National Lead, Cordage, Sugar, American Tobacco, Electric and other high class securities. Now that Congress has adjourned, we look for a much more pronounced movement during the ensuing week, and higher though more widely fluctuating values. Gold exports this week were $1,000,000, against 4¼ millions last week. Fairly large amounts of money are being sent West, in anticipation of the crop news. These shipments will not begin to affect the local markets for some time. Time loans in the East are easy, and below those of last year. New York exchange is at a discount in almost all money centres. The trade outlook generally is reported good. The movement of commodities internally and for export is large, and a good fall trade is expected.

New York Electrical Stock Market.—The activity in the electrical stocks this week was quite pronounced, but confined to a more limited range than in previous similar periods. General Electric was the feature in point of activity and advancing values. Brokers who have been prominent in handling this stock state that the buying orders are mostly for investment purposes. The general public is beginning to appreciate the scope and significance of the development of the electrical science, and in this era of activity in industrial stocks they very naturally turn to the largest of the companies as a good field for investment. The movement was steadily upward, starting on Monday at 109¼ and reaching 115 to-day, with bids at the closing one point above the selling. Points on enormous earnings through increased business as well as expense saved in consolidation are freely distributed; but, aside from the general intrinsic value of the stock, it is not believed that there is any inside movement not yet known to the general public which is carrying up values. In company with the stock debenture 5's were in good demand and advanced four points, closing the week on latter sales at 105⅞; $171,000 exchanged hands. Edison Electrical Illuminating, through the same causes mentioned preceding, was in fairly good demand and advanced a point and a half, closing at 95½ on latter sales; $20,500 of its first sold at figures ranging from 105¼ to 105⅞. The advance in the price of the stock is pronounced as compared with last week, the highest of that week being 92 and the lowest 88. Friends of the stock are predicting par during the present month. American District Telegraph was sold in a limited way each day and showed some weakness, dropping from 63½ to 62¾. It reached the former value in anticipation of the dividend, and, as the time approaches for it to sell ex, it naturally weakens. North American, in sympathy with the better financial condition in Northern Pacific and other of Mr. Villard's interests, showed a hardening in values, ranging around 14⅛ and 14⅞ on limited sales. Western Union, of course, was as usual very active. The range of prices last week was from 96 to 96¼; the opening on Monday was 96¾ and the closing to-day 97⅝. The greater activity took place during the fore part of the week. Westinghouse was not dealt in, owing to the fact that its transactions are placed mostly either at Boston or Pittsburgh.

Boston Financial Review.—The stock market of the week has presented a kind of an anomaly in its weakness and strength. The bull movement was effectual and apparently successful for the few days that it lasted, but when the high prices were reached they proved so attractive as to induce much selling, and where one could see a profit they were not slow to realize on it. This free selling induced weakness, and prices fell back once more to the old figures, but the industrial stocks were in most cases exceptions to this retrograde movement, and held their own, and, in some cases, even continued to advance. One million dollars in gold exports were made this week. There is a better demand for money, and rates are firm, and it is thought that they will soon be advanced on call money. Business paper loans for about 4 to 5 per cent.; call loans are 3½ to 4½ per cent.

Boston Electric Stocks.—There is ominous strength in the electric stocks, and they are rapidly finding their way to higher prices. They lead the industrials, and their history may properly give them this foremost position. General Electric stock has been the leading feature in both the Boston and New York exchanges, and shows an advance of six points during the week, with large quantities of the stock changing hands. The movement started in New York, but Boston quickly responded with a corresponding rise. Brokers are predicting a second Pullman stock for it and it is not an extravagant estimate, for there are few corporations in the country with such a backing as the combined forces of the Thomson-Houston and Edison companies have given the General company. $5,000,000 is set down as a conservative estimate of its first year's net earnings. Only $30,000,000 of its capital is issued; and only $4,000,000 of the bonds. The strongest houses advise its purchase, and assure higher figures in the near future. The bonds have been active, and have risen in price to 103. As direct advice is given also to buy Western Union, which continues to hold its strength. Detroit Electric has been quite active at increased prices. Fort Wayne sold once more at 13, and will not stop at that figure. Westinghouse has not changed any, though it has been traded in quite freely. Its strength is evident, but it lacks buoyancy sufficient for any response to the prevailing conditions for a steady rise. West End railway is gaining continually in net earnings, at a daily rate unknown at any previous time, but it is only slightly reflected in the stock. The telephone stocks are entirely devoid of activity and interest and are simply neglected.

Brush Electric Company.—This company, which is one of the subsidiary companies of the Thomson-Houston Electric Company, the latter owning a controlling interest in the stock, has just issued a statement for the year ending Feb. 1, 1892, and makes an interesting showing. The assets aggregate $4,611,263.94, of which $2,406,898.26 are embraced under the head of patents. Other important items are real estate and buildings, $273,316.02; machinery and tools, $190,467.03; furniture, fixtures and horses, $25,629.43; plants in progress (at cost), $25,555.99; merchandise inventory, $442,538.12, stocks of other companies, less deductions, $645,235; accounts received (general), $348,202.75, less deductions of $112,237.42, $235,965.33; notes receivable, $24,656; Short Electric Railway Company, $221,302. Thomson Electric Railway Company, $18,654; preferred stock less deduction, $78,579.21. Liabilities: common stock, $2,000,000; preferred stock, $500,000; first mortgage bonds sold, $7,000; notes payable, $71,457; unpaid wages, $15,039; contingent liabilities, Short Railway contract, $375,000; total, $3,649,939. The surplus account shows a balance on Dec. 1, 1890, of $929,800.36; adding the gain of $31,472.82 in the 14 months from Dec. 1, 1890, to Jan. 31, 1892, shows a total of $961,275.16. It is stated that the Thomson-Houston has paid about $2,500,000 cash for a controlling interest in the Brush company. Yet in the 14 months ending Feb. 1, 1892, this company earned from the net less than $32,000. Deducting the item of patents from quick assets, and the balance sheet shows net assets of $2,204,000. The liabilities aside from the $2,500,000 aggregate $1,149,000. Deducting this $1,149,000 from the $2,204,000 quick assets (leaving out patents) leaves a balance of $1,100,000 to satisfy the preferred stock and then will be left a balance of $600,000 for the $2,000,000 common stock of 33 per cent. on the dollar.

Increase in Capital Stock.—The Maywood & Proviso, Ill., Electric Light and Power Company have certified to an increase in capital stock from $20,000 to $30,000. The Hudson, Mich., Electric Light Company has increased its capital stock from $15,000 to $25,000.

Postal Telegraph.—The stock of this company has gone up to 68 in the market outside of Wall street without attracting much attention. It was selling at 25 last year. The advance has been on very small transactions. The stock has been hard to get. Mr. Mackay is said to hold 85 per cent. of it. The capital stock amounts to only $10,000,000, and the amount of floating stock is estimated at less than 5,000 shares. The advance in the price was caused by a few insiders discovering that the property was worth a great deal more intrinsically than it was selling for. Some people have thought that the buying meant the absorption of it by Western Union, but this is denied by people who would know. There is an understanding with Western Union by which the rates of both companies are the same, and are strictly maintained, which works to the benefit of both companies. Compared with Western Union, the Postal is regarded as a property about one-fourth the size of Western Union, with a capital of only $10,000,000 against Western Union's $86,000,000 of stock besides its bonds. Western Union has about 13,000 offices, while Postal has about 4,000. Postal is steadily extending its lines in the South and West. It has about 100 lines to Chicago alone. Western Union has about 400 lines to Chicago. It is well known that Postal has been spending a good deal of money each year in construction, and intends to spend a good deal more. Nevertheless, some people think that dividends are not far away, and are willing to buy the stock now in anticipation.

Street Railway Bond Offerings.—E. H Rollins & Sons, of New York and Concord, N. H., offer for sale (at 105 and interest), $367,000 bonds of the Portland, Oregon, Consolidated Street Railway Company. The bonds are dated July 1, 1892, 30-year 6 per cent. first mortgage, sinking fund, and payable in gold. The sinking fund provides that after 1902 ⅒th of the outstanding bonds shall be retired at 105 and interest; and after 1912 ⅒th of the remaining bonds outstanding shall be retired at par and interest. The Mercantile Trust Company of New York is trustee under the mortgage. The financial statement of the company shows:

Capital stock paid in		$700,000
Total bonds issued		760,000
Bonds now offered		367,000
Bonds reserved by trustee to retire bonds now outstanding on various roads in the consolidation		393,000
The bonds of these companies now outstanding are as follows:		
Multnomah Railway	$148.000	
Metropolitan "	145,000	
Portland & Vancouver	100,000	
		393,000

Before the consolidation, and while operating under the old system, for the year ending Dec. 31, 1891, the gross earnings were over $266,000, of which the net earnings were $84,304. Based on the increase of four months in 1892 over the same time in 1891, estimated net earnings for 1892 will be $120,000, which will leave $74,400 surplus, after deducting $45,600 interest charges, or over 10 per cent. on the capital stock. The road embraces the property of four roads, aggregating 27½ miles, and owns power house, equipments and valuable real estate privileges. The franchises are most complete and extend to all kinds of railways in Portland and cover a large territory without the city.

Street Railway Bonds.—The following gives good evidence of the increasing confidence that is being shown in electric street railway bonds. They are legal investments for savings banks in New Hampshire, Rhode Island, Maryland and Pennsylvania, and insurance companies in many other States, as shown below.

Street railway bonds owned by Savings Banks of Maine		$3,183,500
" " " " "	New Hampshire	374,530
" " " " "	Rhode Island	1,134,450
" " " " "	Maryland	95).000
" " " " "	Pennsylvania	777,439
" " " Ins. Companies of	Massachusetts	543,425
" " " " "	Connecticut	202,000
" " " " "	Rhode Island	55,000
" " " " "	New York	2,348 352
" " " " "	Pennsylvania	166 500
" " " " "	New Jersey	104,000
" " " " "	other States	2,900,000
		$12,739,196

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Aug. 6, 1892, in New York, Boston and Chicago:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel	100	3,825,000	63	63½	63¾	63
American Tel. & Cable	100	14,000,000	....	....	87	88½
Central & So. Am. Tel	100	6,000,000	....	....	....	....
Commercial Cables	100	7,716,000	....	....	157½	163
Gold Stock & Tel	100	5,000,000	..	....	100	103
Bonds	500	500,000	....	....	100	..
Postal Tel. & Cable	..	10,000,000	....	....	62	64
Southern & Atlantic Tel	25	948,775	....	....	78	84
Western Union Tel	100	86.199 852	96¾	97⅛	97⅛	97½
Real estate bonds	1,000	1,219,000	....	....	....	..
Debenture bonds	1,000	4,920,000	....	..	....	..
Collateral Trust 5's	1,000	8,181,000	105	105	....	.
North American	100	39.767,200	14½	14⅞	....	....
Brush Ill. Co. of N. Y	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.	100	6,500,000	91	95½	94½	97
Edison El. Il. of Brooklyn	100	750,000	...	....	85	90
" " " " Chicago	100	750,000	....	....	130	145
" " " " Boston	..	.....	....	....	115	125
Edison El. Lt. Europe	1,000	2,000,000	....	....	2	6
" Bonds	..	30,000	....	..	65	80
Edison Ore Milling Co	..	2,000,000	....	....	15	20
East River El Light	100	1,000,000	....	....	....	65
General Electric	1,000	50,000,000	109¼	115	114⅝	115
Automatic Exhibition Co.	..	2,500,000	..	....	3	5
Mt. Morris Electric	..	500,000	....	....	....	65
N. E. Phonograph	..	2,000,000	....	....	2	4
N. Y. Phonograph	..	2,000,000	....	....	2	5
North American Phonograph	..	2,000,000	....	....	4	6
Westinghouse Elec. & Mfg. Co. 1st p. 7 per cent. Cum.	50	3,717,253	....	..	....	....
E. & M. Co. Assg	50	5,038,116	....	....	....	..

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	....	....	8	9
Thomson-Houston Elec.—Series D	sh	120,000	8	7⅝	8	8¼
Thomson Elec. Weld	100	1,000,000	....	....	40	
Thomson European Elec. Weld	100	1,500,000	....	....	10	12
Westinghouse Elec.—New Com.	..	6,000,000	28½	28	28¾	28⅞
Westinghouse Elec.—Pfd.	..	4,000,000	46½	46	46	47
General Electric	..	30,067.200	115	109	114⅜	114¾
" " Pfd	..	4,136,300	120	119¾	119⅞	120
Fort Wayne Elec.	25	4,000,000	13	12⅝	12¾	13
Fort Wayne Elec.—Ser. A.	sh	80,000	7½	7⅜	7½	8
Detroit Elec	10	1,000,000	7¼	7⅛	7⅛	7¼
West End St. Ry. Co.—Com	50	7,150,000	74⅝	74⅛	74	74¼
West End St. Ry. Co.—Pfd	50	6,400,000	88¾	88	88	88¼
American Bell Tel	100	15,000,000	205	203½	203½	204½
Erie Tel. & Tel. Co	..	4,800,000	47	46¾	....	47¼
Mexican Tel. Co	10	1,280,000	1.05	1.02½	1.05	110
New Eng. Tel. & Tel. Co.	..	10,304,600	56¼	55⅝	....	56½
Tropical Tel. Co	10	400,000	....	....	....	20c

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago, ex rights	210	226	Chicago Arc Light & Power Co	98⅛	99¼
Central Union	57⅛	58	Chicago Edison Co.	170	..
Iowa Union	20	25			
Michigan	86	95			
Missouri & Kansas	56	65			

The Copper Market—Copper, which showed an upward tendency at the time of our last report appears to be slightly weaker owing to the *sub rosa* bearish attitude of certain large operators. While these are selling copper nominally at 11¾ cents for lake in small lots, they are making large sales through brokers at a less figure. The exact motive of this cannot be accounted for in any other way than on the supposition that they have large stocks on hand which they are anxious to get rid of. The market is weak in London and stocks are said to be accumulating on this side.

NEW INCORPORATIONS.

The Pittsfield Electric Company, of Naperville, Ill., has been formed with a capital stock of $20,000. Incorporators, George E. Royce, Alvin Scott, Jr., and Alvin Scott, Sr.

The Commercial Telegraph and Telephone Exchange, Chicago, has been incorporated, capital stock $100,000; incorporators, Fred T. White, Frank D. Concannon and L. B. Heillis.

The Electric Annunciator and Indicating Door Plate Company, Chicago, Ill., capital stock, $50,000; incorporators, Michael McInerny, Edward J. Dunn, Martin J. Dwyer and John McKeough.

The Electrical Development Company, of Chicago, Ill., capital stock $1,000,000, has been formed to develop and patent electrical inventions, etc. Frank Weeks, I. H. Pedrick and F. E. Hinckly are the promoters.

The Delta Electric Light and Power Company, of Cairo, Ill., which was recently incorporated with a capital stock of $150,000, with W. Klunge as president, and Harris Schultz as secretary and treasurer, will be ready for business about Oct. 1.

The Lemont Electric Light and Power Company, of Lemont, Ill., capital stock $20,000, has been started to furnish electric light and power. J. G. Bodenschatz, H. S. Norton, P. A. Nelson, F. J. Huston, and Hubert Sauber are the organizers.

The Oro Town and Improvement Company, of Ruby Wash., capital stock $300,000, has been formed to build and operate electric light plants, etc. Robt. Allison, S. C. Stanton, Henry Carr, Robt. Hunter and Chas. E. Laughton are the incorporators.

The Central Electric Company, of Peoria, Ill., capital stock $5,000, has been formed to buy and sell all kinds of electrical machinery, appliances and supplies. O. H. Norton, A. E. Norton, Z. E. Waugh, Chas. E. Stapp and John E. Hemm are the incorporators.

The Diamond Light and Power Company, of Sheldon, Ia., has been incorporated with a capital stock of $50,000 to acquire and operate electric plants, apparatus, etc., at Sheldon, Ia. W. D. Boies, F. G. Turner and Homer W. Conant, of Sheldon, are the incorporators.

The Beacon Electric Company, of Chicago, Ill., capital stock $30,000, has been formed to manufacture and deal in electrical apparatus and supplies, and to operate electric light plants. W. Clyde Jones, Geo. W. McMahon and Geo. L. Cragg are the incorporators.

The Menominee Electric and Mechanical Company, of Menominee, Mich., capital stock $20,000, has been formed to manufacture electric appliances and for general mercantile business. Jos. Fleshein, H. Tideman, J. M. Omsahl, Menominee, Mich., are the incorporators.

The Titusville Electric Light and Power Company, Titusville, Pa., has been incorporated, capital $100,000. Directors: Frank R. Davis, Pittsburgh; B. F. Kraffart, Arthur Mandell, Titusville, Geo. H. Fox, V. Newbert, James McCullough, Jr., Joseph Buffington, Kittanning.

The Binghamton Pulsion Telephone Company, of Binghamton, N. Y., has been incorporated with a capital of $20,000 to construct a telephone line from Binghamton to connect with a large number of towns and villages in Broome county. The directors are N. L. Osborne, G. C. Rogers, E. S. Meeker, George F. Hand, Wm. H. Ireland and Oscar E. Briggs, all of Binghamton.

AFFAIRS OF THE COMPANIES.

The Charleroi Heat, Light and Power Company, of Washington County, Pa., has been chartered with a capital of $5,000.

Granville, N. Y.—The personal property of the Greenwich Construction Company was sold Friday by Sheriff Finch at $8,700, and was bid off by George Bennett, of Schuylerville.

The Garvin Falls Company, of Concord, N. H., has been formed to generate and sell electric power. C. L. Fellows, H. M. Baker, B. Frank Brown, A. Elliott and Wm. A. Russell are the organizers.

The Nashua (N. H.) Light, Heat and Power Company at a recent meeting elected the following officers: President, A. E. Richardson; vice-president, E. A. Pope; treasurer, E. D. Blackwell; manager, W. S. Vincent.

The Bristol & Hebron Telephone and Telegraph Company has been organized in Bristol, Conn., and has applied to the selectmen of Bristol, Bridgewater and Hebron for the right to erect its poles and stretch its wires along the highways of these towns.

The Kissimmee, Fla., Improvement, Manufacturing and Electric Light Company has applied for a charter. The Board of Directors comprise the following well known business men: A. E. Drought, M. Katz, W. B. McKinson, J. H. Dawe and J. F. Cogswell.

Steelton, Pa.—The residents of Steelton effected a temporary organization of a proposed electric light, heat and power company on July 29. Samuel Cuffer was elected temporary president, and Christian Hess, temporary secretary. The capital stock will be $40,000, one-half of which has already been subscribed.

Olean, N. Y.—The Olean Electric Light and Power Company has filed papers with the Secretary of State, announcing that its capital stock has been increased from $30,000 to $35,000. The amount of its debt and liabilities is placed at $16,328.43. The paper on file is signed by Frederick W. Kruse, J. V. D. Coon, N. V. V. Franchot, F. W. Higgins.

The Yuma Water and Light Company has been organized at Saco, Me., for the purpose of manufacturing, dealing in and leasing water-pumping and electric light machinery and operating the same, with $100,000 capital stock, of which $500 is paid in. The officers are: President, Charles P. Hemenway, of Boston; treasurer, John Dodd, of Boston. Certificate approved July 22.

Newark, N. J.—The electric light company expects to increase its capital from $400,000 to $500,000, which is the limit set by the charter. This increase is demanded by the extension of the street railway system and the increased call for lights. Two 100-h. p. generators, two 45-light arc machines, one 1,500-light incandescent dynamo and a 500-h. p. engine will probably be added to the plant this fall.

Champaign, Ill.—The transfer of the electric street railway and city water works from the Union Manufacturing Company to B. F. Harris, Jr., has been completed, and the amount is somewhere in the neighborhood of $225,000. The company operates a line of track three miles in length between Champaign and Urbana, and extensions two miles long. Work has also been begun on a three mile extension through the heart of the best residence portion of the city.

The New Bedford Gas and Edison Light Company, at its annual meeting at New Bedford, re-elected the old board of officers as follows: Directors, Gilbert Allen, Charles H. Gilford, Samuel C. Hart, Horatio Hathaway, Horace Howland, David B. Kempton, George F. Kingman, Thomas H. Knowles, John W. Macomber, Charles W. Plummer, Charles R. Price, William J. Rotch, George R. Stetson; treasurer, Charles R. Price; clerk, Charles R. Price.

The Vermont Electric Company, at a meeting of its directors at Burlington, Vt., elected the following officers: Directors, Dr. Edward Spalding, Charles H. Nutt, J. H. Tolles, F. E. Anderson and F. W. Estabrook; clerk of corporation, J. H. Tolles. At a subsequent meeting F. W. Estabrook was elected president; J. H. Tolles, secretary; F. E. Anderson, treasurer; G. L. Sadler, superintendent of electricity, and Fred W. Norton, superintendent of the gas department.

The Vermont & Boston Telegraph Company.—At the annual meeting of the stockholders the following directors were elected: Norvin Green, Thomas T. Eckert, Charles A. Tinker, R. H. Rochester, of New York; Thomas Roche and Henry C. Sherman, of Boston; R. J. Kimball, of West Randolph, Vt., and George W. Smith and Henry E. Tinker, of White River Junction, Vt. The directors subsequently elected Norvin Green president, Thomas T. Eckert and Charles A. Tinker executive committee, and Roswell H. Rochester secretary and treasurer.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-176 Times Building, New York, Aug. 8, 1892.

Mr. Henry W. Fisher, of Pittsburgh, Pa., electrician for the Standard Underground Cable Company and the C., D. & P. Telegraph Company, has been in New York this week purchasing instruments for fitting up a laboratory for the latter company.

The Edison Manufacturing Company has removed to 110 East Twenty-third street, where it has elegantly equipped and well appointed offices. Mr. W. B. Stewart has been appointed general sales agent. The above company has just brought out a new battery fan motor which has many excellent features.

Mr. William H. Truex, for the past four years with the Metropolitan Telephone and Telegraph Company, has resigned from that company to take the position of district superintendent of the Pennsylvania Telephone Company with headquarters at Easton, Pa. His division will be the Lehigh Valley district, viz., from Mauch Chunk, Pa., as far east as Hackettstown, N. J. Mr. Truex is an experienced and practical telephone man with many friends, all of whom wish him success in his new field.

Dr. S. S. Wheeler, president of the Crocker-Wheeler Electric Company, sailed Aug. 3 on the Germanic for a much needed vacation. He has taken with him letters of introduction to the principal electrical men in Europe, and will consult with them upon matters of interest to the electrical profession. He will call upon the company's agents in London, the General Electric Company. He will also visit the principal central stations to gather from their experience anything that may benefit the interests of the company of which he is president.

Prof. F. B. Crocker, vice-president of the Crocker-Wheeler Electric Company, arrived on the Teutonic Aug. 3 after a six weeks sojourn abroad. He has seen in this short time nearly every electrical engineer of note, has visited the principal central stations and works of Europe, and has taken a general survey of the electrical field. He says that one of the principal motor manufacturers told him with a great deal of pride that they had made as many as two hundred small motors. He also says that there are only about ten electric motors working in Vienna and but few more in Paris and Berlin. The number of motors used in London is somewhat greater, the larger part of them being Crocker-Wheeler.

Mr. Thomas T. Dennis died on the morning of July 30, at his home, 342 St. Nicholas avenue, N. Y. City. Mr Dennis was born in the West about 54 years ago. He served during the war in the United States Military Telegraph corporation. About twenty years ago he became the manager of the Western Union branch office in the Fifth Avenue Hotel, which was at that time one of the most important branch offices in the city, where he remained for 12 years. The next few years he was in charge of the branch office at No. 599 Broadway. When the pneumatic tube system was first adopted by the Western Union Company, some six years ago, Mr. Dennis was placed in charge of it at the general office of the company, and occupied that position until about a year ago, when ill health compelled his resignation. Mr. Dennis was one of the best known telegraphers in the country, and was a man possessed of considerable mechanical genius. L. H. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 28, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Aug. 6, 1892.

The New Interstate Electric Road running between North Attleboro and Pawtucket, R. I., is open now for traffic.

Mr. F. A. Magee has resigned his position as New England Manager for the Underwood Manufacturing Company.

F. G. Waterhouse, representing Waterhouse Bros., Hartford, Conn., is showing a sample of their well-known lamp to the trade at the Hub this week.

R. Hollings & Co., of 547 Washington street, will move to 525 Washington street about Sept. 1 on account of the present property being sold for Keith's new theatre.

The New England Telephone and Telegraph Company will run a long distance wire to Bellows Falls, Vt., the completion of which will make a circuit of 1,000 miles long.

President Whitney, of the West End Railway Company, is reported as saying that this company would commence work on its new line in Cambridge at once, this extension being made to accommodate the East Cambridge traffic.

A company of capitalists is forming for the purpose of manufacturing cotton ropes for power transmission under the Lambeth patterns. Mr. Arthur A. Brigham, of 186 Devonshire street, Boston, is the selling agent for this well known rope.

The Ashton Valve Company, Boston, Mass., has bought the entire plant, material and business of the Boston Steam Gauge Company. Mr. H. L. Willard, the former manager of the Boston Steam Gauge Company, will continue with the Ashton company. The officers of the associated interests are the same as the old Ashton Valve Company.

The Thomson-Houston Company has completed and put into operation the first electric mill tram road in Chicago, at the works of the Northwestern Terra Cotta Company. The line is 1,700 feet long, including the loop. The overhead conductors consist of two No. 2 B. & S. gauge copper wires. As the power is supplied from an incandescent lighting plant, it was deemed advisable not to use one wire and rail for return current, so a double-trolley system was installed. The line has six curves of less than forty feet radius. A loaded train can start from the works and unload in the storage yard, and continue to the clay sheds for a return load for the works. The track is three feet gauge, has a thirty pound T rail on pine ties, spaced two feet between centres. The greatest grade is four per cent. The motor car is equipped with two three horse power Thomson-Houston railroad motors, hung on the axles. The motor has the standard Thomson-Houston controlling stand and switch. The motor has hauled ten tons on a level track. W.R.W.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, Aug. 6, 1892.

Mr. A. D. Adams, the general sales agent of the Jenney Electric Motor Company, was in Chicago this week closing some important contracts.

Mr. and Mrs. W. H. McKinlock have the sympathy of their many friends in the loss of their youngest daughter, Wilhelmina H., aged 10 months and 30 days, which occurred on Thursday, Aug. 4.

An Elevated Electric Railway.—Mr. A. Shillinglaw, chief electrician of Armour & Co.'s numerous plants, is building an elevated railway in the Union Stock Yards, Chicago, to transfer freight about their great building. This line will be operated by electric motors.

Mr. J. C. Liggett, the electrical inspector for the Michigan Chapter of the American Institute of Architects, and for the Michigan Inspection Bureau, ran over from Detroit this week to arrange for the handling of the Turbayne arc lamp, in which he is interested as a member of the firm of Liggett, Turbayne & Company, who are manufacturing an arc lamp for alternating current circuits.

Electrician Ernest P. Warner, Commodore of the Lincoln Park Yacht Club, and owner of the sloop yacht Phantom, will sail his boat in the regatta at Charlevoix, Mich., Aug. 10. The course will be a triangle, 25 miles long, on Lake Michigan. Efforts were being made this week to have several other Chicago yachts go to Charlevoix in company with the Phantom. Commodore Warner is confident of winning the cash prize of $150, given by the Little Traverse Boat Club.

The Jenney Electric Motor Company, of Indianapolis, Ind., has appointed Doddridge & Wolfrum local agents for the city of Chicago and Cook county for the sale of its electric power and lighting apparatus. Mr. Wolfrum is well known for his active work in connection with the Detroit motor, and there is every indication that he will be very successful in placing the Jenney motor. Mr. Doddridge is well known in Chicago, having resided here some twenty years, and having been a number of years in the electrical business. Their office is at 320 Rookery Building, Chicago, Ill. F. de L.

CANADIAN NOTES.

Ottawa, Aug. 1, 1892.

Montreal.—The street railway directors now propose to run to Longue Pointe, and are at work making terms with the municipalities to that end.

Belleville, Ont.—Belleville gets $250 a year and other concessions for exclusive rights for ten years to the Bell Telephone Company. It is also to be made the central switch station for the Midland district.

Peterborough, Ont.—Nearly 500 men are now employed in the various departments of the Edison works, Peterborough, owing to the large number of contracts on hand. The pay sheet of the company last week amounted to $3,500.

Nanaimo, B. C.—Two large electric locomotives for the New Vancouver Coal Company, to be used in No. 1 shaft, were brought over on the steamer Cutch last week. They will be sent to the mine some time during the present week.

Winnipeg.—The fight between the Winnipeg street railway and the new electric company, which has just begun to run cars, will be settled by the courts, the manager of the former company having applied to the judges for an injunction to prevent the electric cars from running. The old company claims to have the sole right of running cars.

Montreal.—Owing to increased traffic on the street cars since the introduction of the cheap rates the management put on several extra cars last week. The company applied to the city surveyor for permission to build a track on Victoria square from St. James to Craig street in order that the Point St. Charles cars may run right up to St. Denis street, and vice versa. The contract stipulates that the company must have 10 miles of electric road in operation before Sept 1.

Ottawa, Ont.—It is understood the City Passenger Railway Company will make proposals for an amalgamation with the Electric Railway Company if they get power from the city to change their system, and it would seem that the former company was desirous of having the corporation act as mediator between the two companies. In the event of amalgamation the old company would surrender its perpetual charter, provided the new company was given a charter for 30 years.

Ottawa, Ont.—Lemuel Bannister, vice-president and general manager of the Westinghouse Electric Company, arrived in the city Saturday. He was particularly pleased with the electric railway and the efficient manner in which it was operated. In the matter of electric heating he considers that Ottawa has taken a lead, and the inventions of Mr. Ahearns in that department are of great value. Mr. Bannister, in company with Mr. Soper, left via the Canadian Pacific for the West

GERMAN NOTES.

Berlin.—As the trials made with the electric light on one of the omnibus lines in Berlin have proved satisfactory, it is intended to adopt electricity for lighting all the vehicles of the omnibus company, as well as the cars of the Berlin steam tramways.

The Thomson-Houston System in Germany.—The contract for the equipment of an electric tramway in Remscheid, Westphalia, has been given to the Union Elektricitäts Gesellschaft of Berlin—the German Thomson-Houston Company. Among the competitors was the firm of Siemens & Halske. The road will have grades up to 10.4 per cent.

Breslau.—The construction of the projected electric tramway here will be taken up very shortly. The rails are already on the way, and they will be laid at once. The new double track will traverse the city in all directions, and will at the same time afford communication between the city and the suburb of Gräbschen and the Scheitniger Park. The whole of the work is to be completed by July, next year, though it is hoped that a portion will be ready for traffic next spring. The total length of rails will be about 18 miles—a development not yet attained by any system of electric tramways on the continent of Europe.

Cologne.—The official inauguration of the Cologne City Electricity Works took place on June 24, and was attended by the municipality, the Town Councillors, and the representatives of other civil and military bodies. The Mayor, Herr Thewalt, in his opening speech recalled the history of public lighting in Cologne, referring to the fact that after the city had closed an agreement in 1850 with the English Gas Company, giving to the latter the public and private lighting for a term of 25 years, the public purse had been drained of some millions of money for three decades, merely for the sake of a trifling benefit, and the money had, moreover, been sent out of the country. This, he went on to say, would have been the case to-day as well, had it not been for the foresight exercised by the Town Councillors in preventing a prolongation of the agreement. About the beginning of the 70's the city took over the gasworks, and the demand had developed to such an extent that, with 5,600 lamps for the free public illumination of the city there had resulted a profit of $2,750,000, including the capital invested in extension of the works. A sum of $460,000 had been voted by the city authorities for the erection and equipment of the electricity supply station. The station was planned for a maximum capacity of 20,000 lamps burning at one and the same time. The wisdom of the project and of the decision in adopting alternating current and transformers had been sufficiently evidenced. While at the time of the opening of the station on Oct. 1, 1891, there were 1,880 lamps on the circuits, there were on April 1 last no less than 184 installations on the books with 13,331 incandescent lamps, each of 16 c. p., or their equivalent (10 incandescent lamps reckoned to one arc lamp). Of these a total of 10,707 lamps were actually installed. The financial results of the first half-year's running were highly satisfactory. The price for current consumed is calculated on the basis of 2 cents for every 100 watt-hours indicated by the meters. This means 1.1 cents for the 16 c. p. lamps per hour, when taking 55 watts; the cost of burning an arc lamp of 400 c. p. having a current consumption of 350 watts is 7 cents per hour. In the case of very large current consumption and large number of lamp-hours subscribers are allowed a considerable discount ranging from 25 to 40 per cent, according to a fixed scale. The possibility of a reduction in the price of the electric light need not be remote in Cologne, in view of the contingency of an extension of the station having been fully provided for in the system adopted, and the cause of the only one complaint of many customers would then be effectually removed. In this connection it may be remarked by way of comparison that the price of gas in Cologne is lower than anywhere else in Germany; it amounts to only 3.75 cents per cubic meter.

Inquiries from Correspondents.

Queries to be inserted in this column must be of general electrical interest, and must be accompanied by the real name and address, not necessarily for publication, but as a guarantee of good faith. No notice will be taken of questions which involve nothing more than can be found in elementary treatises on the subject. All correspondence should be as brief as is consistent with clearness. Readers are invited to send discussions and answers to these questions.

[123.] Is there any incandescent lighting plant in the East that feeds lamps twelve miles distant from the station? A. H.

[124.] In the Thomson-Houston, separately excited, compound-wound, alternating generator, is the current required for the compound or series winding taken from the main circuit, and what is its circuit through the special commutator and the armature? J. L. W.

[125.] Can I charge a storage battery, consisting of four Julien cells, where the rate of charge must not be greater than four ampères, with 115 volt, incandescent, compound dynamo of eight 16-c. p. light capacity? C. S. W. S.

Answers to Correspondents.

Readers are invited to send discussions regarding, or answers to the queries published in Inquiries from Correspondents or with regard to any other live questions on electrical subjects. In answering questions please refer to them by their serial number. Correspondence must be accompanied by the real name and address, not necessarily for publication, but as a guarantee of good faith. Names of correspondents will be printed in full unless otherwise requested. All correspondence should be as brief as is consistent with clearness. The Electrical World assumes no responsibility for the opinions expressed by correspondents.

[122.] It would be practicable to connect a motor between the trolley and ground of a street railway system if the motor be wound for that voltage, or a motor of any voltage might be inserted with proper resistance in series with it, although such an arrangement would not be economical. In any case great constancy of speed could not be expected on account of the fluctuations of the voltage of the railway circuit. C. D.

[122.] In this city (Champaign, Ill.) at least 20 small motors are used, coupled directly in circuit between the earth and the trolley

wire of a 500-volt railway circuit. Many business houses are lighted by lamps placed five in series across the circuit, and three newspapers in this city and Urbana, adjoining, use from five to ten horse power each, derived from the same source. Five hundred volt motors are used for power, and five 100-volt lamps in series, for light. General satisfaction is expressed, the only trouble being a slight varying of the c. p. of the lamps. J. S. S.

[124.] In the Thomson-Houston separately-excited, compound-wound, alternating generator the current for the compound or series winding is taken from the main or armature circuit. Its path is armature, external circuit, commutator, fields, commutator, armature. ED.

[125.] The four Julien cells could be charged by the dynamo mentioned. Insert eight or ten 16-c. p. lamps in series with the cells and the proper current would be obtained. ED.

News of the Week.

THE TELEPHONE.

Peoria, Ill.—A fire recently destroyed all the telephone connections in the city.

THE ELECTRIC LIGHT.

Sherwood, Mich., is to have the electric light.

Hedrick, Ia., is discussing the question of electric lights.

Clyde, O., is anxious to have its streets lighted with electricity.

Edwardsville, Ill., is advertising for proposals for an electric light plant.

Hopedale, Mass., is arranging a contract for lighting its streets by electricity.

Sprague, Ore., has floated bonds, and will in the future own and control its water and electric light plant.

The West Duluth (Minn.) Electric Company contemplates purchasing a 50-light arc dynamo for its plant,

Cripple Creek, Colo.—Two electric light companies are competing for the privilege of putting in plants in the lower and upper towns.

The Toledo (O.) Electric Light Company's Works were destroyed by fire on July 31. The loss is estimated at $75,000, with $61,500 insurance.

Lafayette, Colo., is to have an electric light plant. There is also talk of building an electric road from Denver to Lafayette, Louisville and Boulder.

Sauk Centre, Minn.—The Davidson Mill, the electric light works and the city water works have been destroyed by fire at a total loss of about $60,000.

Kewanna, Ind.—The owner of the Peru electric light plant is endeavoring to locate a plant at Kewanna. Local capitalists are also interested in the same scheme.

Ewen, Mich., is to be lighted by electricity. A dynamo in the mill of the Ontonagon River Lumber Company will furnish sufficient power to light the streets and business places.

Perry, N. Y.—The Perry Electric Light and Power Company has obtained a contract for lighting the streets for a period of five years with 20 arc lights. The works are to be in running order by Nov. 1.

Wilmington, O.—The lighting plant is now completed and the electrical department is now in the market for electrical supplies. Considerable inside wiring is also to be done. Mr. J. C. Martin is the manager.

The Minneapolis (Minn.) City Council has awarded the contract for lighting the streets to the Brush Electric Company and the gas company for a period of five years. Six hundred or more electric arc lights will be be taken at $150 per year.

The Citizens' Electric Light Company, of Logan, O., capital stock $15,000, has been formed to manufacture and furnish electricity for lighting purposes. Henry Lutz, G. H. Hartman, L. Wamen, Wm. H. Hartman and W. H. Lutz are the promoters.

Spring Valley, Ill.—The electric light ordinance has been signed by Mayor Duggan, and work is expected to commence at once. The city will take 30 arc lights of 800 c. p. each, and have given E. B. Hillman & Company, of Peoria, a franchise for 20 years.

The Elkton (Md.) Electric Light and Power Company is advertising for sealed proposals for the entire equipment for an electric light plant, including electrical apparatus, poles, wiring, lamps, boilers, engines, steam pumps, etc. Bids will be received until Sept. 5, 1892.

Toledo, O.—The committee of the directors of the Toledo Electric Light Company appointed to investigate and report on a suitable site for the proposed new electric light station has reported in favor of the lot on Water street near Lagrange street, and next to the Vulcan Iron Works.

The Fort Wayne Electric Light Company is seeking a franchise from the city council of Kansas City, Mo., to construct and operate an electric light plant in that city. The company will not ask the city for any street lighting, as it looks to commercial lighting for its revenue.

Cincinnati, O.—A rapidly revolving iron pulley eight feet in diameter burst in the Brush Electric Light Works on Broadway, near Hunt street. An engine was destroyed by it, a portion of the building torn away, and a piece of the wheel crashed through the wall of a tenement house 100 feet away.

The Binghamton (N. Y.) Common Council has granted a franchise to the Binghamton Electric Light and Power Company to erect and operate an electric lighting plant in that city. The organization of the company, which is composed of prominent local capitalists, has not yet been completed.

THE ELECTRIC RAILWAY.

Dixon, Ill., is to have an electric railway.

Huntington, Ind., wants an electric railway.

Huntingdon, O.—The belt horse car and electric street railway have been consolidated.

Pontiac, Mich.—A company has been organized to build a street railroad to Orchard Lake.

The New Wheeling (W. Va.) Street Car Company is to change its motive power to electricity.

Raton, N. M.—It is reported that Raton and Blossburg will soon be connected by an electric railway.

Hartford, Conn.—The first electric car between City Hall and East Hartford has been started, and hereafter regular trips will be made.

Milldale, Ky.—The board of town trustees has agreed to the proposition of an electric railway, and it will be constructed in the near future.

Ithaca, N. Y.—The Tioga street electric line is to be extended to the railroad landing, and a new bridge will be built over Cascadilla Creek to avoid the curve there.

The Oskaloosa (Ia.) Street Car Company has secured a loan of $100,000 from the New York Loan and Trust Company to build seven miles of electric railway to Oskaloosa.

Trinidad, Colo.—It is reported that the Trinidad street railway has been sold to a New York syndicate, and that $50,000 will be expended in converting it into an electric line.

The Fountain & Suburban Street Railroad Company, of Hot Springs, Ark., Edward Hogaboom, president, is arranging for the building of its electrical railroad.

Baltimore, Md.—E. D. Smith & Son, contractors for the construction of the Maryland avenue electrical railroad of the City & Suburban Railway Company, have commenced work.

Lansing, Mich.—The electric railway will be extended to the Agricultural College at once, in case the township will allow the track to be laid along the edge of the graded roadbed.

Phœnix, Ariz.—The city council has granted franchises to two companies, who will commence at once to construct electric lines in various parts of the city; over fifteen miles of road will be built.

Ashland, Wis.—The horse-car system of Ashland is to be replaced by an electric line, the company having let a contract to the Thomson-Houston Co. for $150,000. The work is to be done in four months.

Oakland, Cal.—It is reported that the California Improvement Company has purchased the horse railroad between Oakland and Alameda, owned by Theodore Meetz, and intends to equip the line with electricity.

Columbus, O.—An ordinance has been passed granting a franchise to the Columbus and Westerville Electric Railway Company to extend its lines over various portions of the city. About $400,000 will be spent in building and equipping these extensions.

Niles, O.—It is reported that the Youngstown Electric Railway Company has secured the right of way from the property holders between Niles and Girard, and will seek a franchise from the county commissioners for the construction of a road between those two points.

The Sandusky, Milan & Huron Electric Railway Company, of Sandusky, O., capital stock $100,000, has been formed to build and maintain street railways to be operated by electricity or other power. W. H. Gilcher, Thos. Wood, Geo. H. DeWitt, John T. Mack and T. H. Taylor are the incorporators.

The Mohawk Valley Electric Light and Power Company, of Canajoharie, N. Y., has been formed with a capital stock of $40,000. Directors: George H. Smith, of Canojaharie; David Zieley, Jr., of Brooklyn; Edwin N. Sanderson, of Fort Edward; Irving Miller, of Palatine and Octavio A. Zavas, of Dobb's Ferry.

The Ashland (Wis.), Lighting and Street Railway Company, at a recent meeting, let the complete contract for changing the present horse-car system to an electric line to the Thomson-Houston Electric Company, of St. Paul. The entire cost is estimated at $150,000, and work will be completed in about four months.

LEGAL NOTE.

Suit for $500,000.—Dr. Robert d'Unger, owner of the d'Unger patent, proposes to sue the city of Chicago for $500,000 damages, and says the suit will be immediately brought in the United States Circuit Court. Three patents were issued to him granting him permission to use, sell or manufacture his telephone in any part of the United States, and he claims that the city of Chicago in refusing him a franchise has prevented him from exercising the privileges granted by the National Government through the patent office. In consequence of this he asserts that he has suffered an actual cash loss of $50),000.

MISCELLANEOUS NOTES.

The Phonoplex, an invention of Mr. Edison, has recently been given a trial on the lines between Denver and Colorado Springs, and it is reported that its working is very satisfactory.

The Dixon (Ill.) Electric Lighting and Power Company has purchased a mill and water power privilege for $20,000. This water power will be used for supplying power to the surrounding mills and factories and for an electric road which the company is to build.

Industrial and Trade Notes.

The Boston Electric Company is showing a very novel fan motor. It is gotten out in several styles so as to suit all kinds of work.

The Redding Electric Company, Boston, will in a short time introduce many new specialties. It is receiving many orders for its well known watch clock.

The Tucker & Leavitt Chemical Company, 16 Grand street, New York, is meeting with excellent success with the Hercules motors and reports large sales.

The Jenney Electric Motor Company has recently sold a 300-light machine to the Danville Woolen Mills, Danville, Ill., and one of the same capacity to Butler University, Indianapolis, Ind.

A New Oil Filter.—Mr. I. L. Faucett, of Quincy, Ill., is placing on the market the Gem City Oil Filter and Purifier, which has been highly indorsed by electrical street railway and lighting companies for its economy in the saving of oil.

The Barney Ventilating Fan Company, of 70 Pearl street, Boston, has sold two 60-inch fans to the Boston Electric Light Company for ventilating the dynamo room of its Congress street station, and has shipped a 48-inch fan to the Fall River Electric Light Company to be used for the same purpose.

The Sioux City Electrical Supply Company has added $12,000 to its paid up capital. It is now operating a brass foundry, making a specialty of electrical castings and also doing a general jobbing business in casting copper, lead, zinc, tin, aluminium and antimony, making solder, babbitt, commutator bars, etc.

The Bigelow Electric Supply Company, of Lincoln, Neb., has recently installed an 800-light plant at the insane asylum Hastings, Neb., an 800-light incandescent plant in the Western Normal University, Lincoln, Neb., and one 500 incandescent light plant in the Lincoln Normal University, all of the Duplex Electric Company's manufacture.

A Large Contract.—It is not often that an electrical contract of $300,000 is awarded, hence there has been a very severe competition over the contract for the equipment for 17 miles of road for the Cuyadutta Electric Railway Company. The contract has been finally awarded to H. Ward Leonard & Co., of New York City, who act as bulk electrical contractors for the entire equipment of the road including building, steam plant, electric generators, track work, bridges, overhead work, cars, etc.

The Electric Appliance Company announces the securing of the agency for the Elkhart transformer, and will handle the Western trade. The Elkhart transformer has had a record remarkable in a great many respects. It began its career in a quiet way about a year ago, and the manufacturers claim that they have never yet sent out a sample machine that has not resulted in securing them the transformer business of the customer. It is now being used exclusively by a number of the largest plants in the country.

A Bright Idea.—"The Kolon Primer" is the title of a neat pamphlet issued by Converse D. Marsh, 136 Liberty street. Replete with illustrations it furnishes many interesting points that the average person is likely to omit in charging primary batteries. Every step in charging the Kolon cell is illustrated, so that there may be no possibility of error even where dense ignorance prevails on electrical matters. The primer is supplied with every Kolon primary battery and is already in its second edition.

Bemis & McLennan, 85 Dearborn street, Chicago, are placing a line of graphite specialties on the market that includes lubricants, gear, car and motor grease, curve grease and graphited oils; a graphite pipe cement found especially serviceable for manhole gaskets, as the cement is said not to stick to the surfaces and can be taken apart many times without injury to the gaskets; and graphite paint that has been found valuable to the central station manager desiring to preserve exposed iron work from the destructive effects of the weather.

The Campbell & Zell Company, of Baltimore, Md., has just been awarded the contract for one 200-h. p. Zell improved water tube safety boiler by Messrs. Wm. H. Bunge & Co., of Chicago, Ill., making in all 900 h. p. of boilers sold during the month of July, to be erected in the city of Chicago. The remarkable progress made in the introduction of the Zell boiler, it is claimed, is due to its superiority. This boiler is well made, unique in the possession of several features which are to be found in no other boiler, and has been practically demonstrated as a reliable generator of dry steam.

The Joseph Dixon Crucible Company, of Jersey City, N. J., continues to find new uses for its graphite. A user writes that he has used handhole and manhole gaskets eight or ten times by carefully smearing the surface next the boiler shell with graphite, and these were taken out at from periods of three or four weeks, the steam pressure being as high as 100 lbs. In packing water glasses by putting a little graphite and oil on the gaskets they would become soft and retain their elasticity until the glass was changed, when the old rubber could be removed without any trouble. It has also been found useful for painting flanges, studs, nuts, etc.

B. W. Payne & Sons, 41 Dey street, New York, have received the following orders for their improved high-speed Corliss engines, which are giving such good satisfaction: Hotel Balmoral, New York, 100-h. p. engine for electric lighting; Thomas Taft, Cornwall, N. Y., 125-h. p. engine for central station; Elmira Silk Mills, 150-h. p. engine; Elmira (N. Y.) Street Railway Company, 300-h. p. triple expansion engine; Pen Argyl (Pa.) Electric Light and Power Company, 100-h. p. engine; Haverstraw (N. Y.) Electric Light Company, 100-h. p. engine; Muscogee Cotton Mill Company, Columbus, Ga., 200-h. p. engine, and one 100-h. p. engine shipped to Belgium.

H. Ward Leonard & Co., bulk electrical contractors, during the past thirty days have closed the following contracts: Port Richmond Prohibition Park Railway, Port Richmond, S. I.; J. S. Kennedy's residence, Bar Harbor, Maine; New Netherlands Hotel, New York City; Racquet and Tennis Club, New York City; Delaware, Lackawanna & Western Building, New York City; the Betz Building, Philadelphia, Pa.; the Havemeyer Building, New York City; the Continental Corset Company Building, Newark, N. J.; I. N. P. Stokes' residence, New York City; the Broadway Power House, New York City; the Cayadutta Electric Railway, Gloversville, N. Y.

The Fort Wayne Electric Company's branch at Philadelphia, with G. A. Wilbur, manager, has been doing considerable business the past two months and among the many sales made are to the City of Lebanon, Pa., two 60-light Wood arcs; Shamokin Street Railway, one 60-light Wood arc; Hamburg Electric Light and Power Company, one 60-light Wood arc; Reading Electric Light and Power Company, five 60-light Wood arc machines and lamps; Souther Electric Light and Power Company, Philadelphia, Pa., four 60-light Wood arcs; Manufacturers' Electric Company, Philadelphia, Pa., one 100-h. p. Wood generator. The Wood arc dynamo is reported as giving satisfaction, and sales are increasing.

The Ball Engine Company, Erie, Pa., has shipped during the last three weeks the following among others: Compania Mexicana y Luz Electrician, City of Mexico, two 60-h. p. engines, two 60 h. p. heaters; Hot Springs Electric Company, Hot Springs, Va., one 100-h. p. engine, two 80-h. p boilers, one 200-h. p. heater, one 200-h. p. pump; Brooklyn Navy Yard, Brooklyn, N. Y., one 80-h. p. engine; Northwestern Supply Company, Tacoma, Wash., one 25-h. p. engine; Diamond Light and Power Company, Sheldon, Ia., one 80-h. p. engine; North Hudson County Railroad Company, Hoboken, N. J., one 250-h. p. engine; Fort Clark Street Railway Company, Peoria, Ill., one 130-h. p. engine; Boulder Electric Light Company, Boulder, Colo., one 100-h. p. engine, one 100-h. p. boiler, one 150-h. p. pump, two 100-h. p. heaters; Shamokin Street Railway Company, Shamokin, Pa., one 130-h. p. engine; North Avenue Street Railway Company, Baltimore, Md., two 130-h. p. engines; Mt. Vernon Electric Light Company, Mt. Vernon, O., one 150-h. p. engine; Metropolitan Telephone Building, New York City, one 60-h. p. engine; Le Gran Fundicion Nacional Mexicana, Monterey, Mexico, one 60-h. p. engine.

Warren Webster & Co., manufacturers of the Webster Vacuum Feed Water Heater and Purifier, during the month of July received the following orders: V. D. Anderson & Co., Cleveland, O., one 80-h. p.; Mechanical Fabric Company, Providence, R. I., one 400-h. p.; Carlisle Water and Gas Company, Carlisle, Pa., one 200-h. p.; Savannah Gas Works, Savannah, Ga., one 60-h. p.; Pennsylvania Steel Company, Steelton, Pa., first order, one 400-h. p., second order, one 2,000-h. p.; Detroit Sheet Metal and Brass Works, Detroit, Mich., one 125-h. p., for Telephone Building, Detroit; Onderdonk Heating and Ventilating Company, Philadelphia, one 30-h. p.; Mt. Holyoke Seminary and College, Holyoke, Mass., one 150-h. p.; J. Horace McFarland Co., Harrisburg, Pa., one 30-h. p.; Harrisburg Boot and Shoe Company, Harrisburg, Pa., one 150-h. p.; N. & G. Taylor Co., Philadelphia, one 100-h. p.; D. M. Bare & Co., Roaring Spring, Pa., one 1,000-h. p.; Lorraine Manufacturing Company, Saylesville, R. I., one 750-h. p. The orders received for the Williames vacuum system of steam heating were as follows: Armour & Co., Union Stock Yards, Chicago, Ill.; Galloway College, Searcy, Ark.; Smith Building, Chicago, Ill.; Harrisburg Boot and Shoe Company, Harrisburg, Pa.; J. Horace McFarland Co., Harrisburg, Pa.

The Rodney Hunt Machine Company has nearly completed the large addition to its shops and machinery. This extension of the plant is imperatively needed by the rapid growth of the water wheel and woolen machinery business of the company. The company at present is making and setting their turbine water wheels for the following parties: Appleton Company, Lowell, Mass., three pairs of 42-inch wheels, horizontal shafts in iron cases; Manufacturing Investment Company, Madison, Me., two pairs of 42-inch horizontal shaft wheels, making 12 wheels sold to this company; Rochester Paper Company, Rochester, N. Y., two pairs 33-inch horizontal shaft wheels, making eight wheels sold to this company;

Dundee Land and Water Power Company, Passaic, N. J., one 2 inch horizontal shaft wheel in iron case, making three wheels sold to this company; Glen Manufacturing Company, Berlin Falls, N. H., three 66-inch horizontal shaft wheels, making 9,000 h. p. in wheels sold to this company; Empreza Electricide, Piracicaba, Brazil, S. A., two pairs of 15-inch wheels, horizontal shafts in iron cases; Fall Mountain Paper Company, Bellows Falls, Vt., one 36-inch horizontal shaft wheel, making 90 wheels used in its different mills; Cowan Woolen Company, Lewiston, Me., one 36-inch vertical shaft wheel; E. L. Chandler, Barton Landing, Vt., one 36-inch vertical shaft wheel; Hollinsworth & Vose, East Walpole, Mass., one 27-inch vertical shaft wheel; Farmington River Power Company, Hartford, Conn., two pairs of 30-inch horizontal shaft wheels, making 10 wheels sold to this company; Olcott Falls Company, Olcott Vt., one 30-inch horizontal shaft wheel, making 35 whee ls sold to this company and more than 16 others.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Well Pleased With It.—Mr. F. W. Little, president of the Lincoln, Neb., Street Railway Company, states the following regarding Houston's Dictionary of Electrical Words, Terms and Phrases: "I have examined Houston's Electrical Dictionary with considerable care, and am well pleased with it."

Two Harvest Excursions—Half Rates to the West.—Aug. 30 and Sept. 27—on these dates the Burlington Route will sell tickets from Chicago, Peoria and St. Louis to the farming districts of Nebraska, Colorado and Northern Kansas. Half rates will apply, and tickets will be good for 21 days. Nebraska in one year produced 300,000,000 bushels of corn, besides other grain, fruits and live stock. Write for free pamphlets, etc., to P. S. Eustis, G. P. A., Burlington Route, Chicago, Ill.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

U. S. PATENTS ISSUED AUGUST 2, 1892.

479,782. Mechanical Telegraph Instrument; Benjamin F. Butler, Logansport, Ind. Application filed May 16, 1892. The combination with a base-plate, a bell-crank, a rod or bar connecting one arm of the bell-crank lever with the sounder, an arm connecting the other arm of the bell-crank lever with a key and a spring for maintaining the key and sounder in their normal positions.

479,786. Galvanic Battery; Martin M. Clark, Chicago, Ill. Application filed Jan. 9, 1892. In an electric battery, the combination, with a cup shaped positive element adapted to surround and inclose the electrolyte and negative element, of a porous cup immersed in the electrolyte, a negative element within said electrolyte, a negative element within the porous cup and surrounded by a depolarizing substance, a packing of fibrous material above the electrolyte, a suitable sealing material adapted to close the battery, and a tube secure to the positive element and extending through the sealing and packing material to the electrolyte, the tube being provided with a removable closing-cap.

479,795. Valve Controller; Charles L. Fortier, Milwaukee, Wis. Application filed Mar. 5, 1892. In an electric valve, the combination of a valve-case having supply and exhaust connections, an armature within the case, provided with valves controlling the connections, pole pieces in proximity with the armature, and magnets connected with the pole-pieces and armature, one of the magnets having a differential winding, whereby its polarity may be reversed.

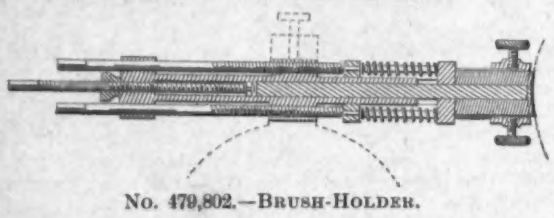
479,802. Brush-Holder; Francis J. Haeseler, of the United States Navy. Application filed Nov. 5, 1891. In a brush-holder, the combination, with a frame, of a copper brush fitted in the frame, a carbon brush in contact with the copper brush and normally pressed forward by a plurality of springs, and a regulating screw passing through the rear end of the frame and adapted to adjust the tension uniformly on all of the springs, and a clamp-screw set in the frame and adapted to clamp the carbon brush when desired. (See illustration.)

479,804. Electro-Magnet Bobbin; Edward B. Hatch and Charles E. Colton, Hartford, Conn. Application filed Jan. 13, 1892. In an electro-magnet, in combination, a metallic core, a bobbin with projecting flanges of partially vulcanized india rubber and asbestos composition in a single piece, and helices of wire wound about the bobbin between the flanges.

479,809. Closed Conduit for Electric Railways; Edward H. Johnson, New York. Application filed Feb. 10, 1887. In an electric railway, the combination, with the working conductors normally disconnected from the source of electrical energy, of iron balls or rollers and a magnet on the car moving the balls or rollers by magnetic attraction into position to connect the working conductors in circuit as it passes over them.

479,814. Electrical Water Heater; Rankin Kennedy, Kilmarnock, Scotland. Application filed April 1, 1891. The combination of an endless tubular core with a magnetizing coil and a source of alternating or pulsatory electric currents. (See illustration.)

479,821. Electric Switch; Andreas Peter Lundberg, London, England. Application filed Dec. 29, 1891. The combination of a squarely recessed base, angular contacts fastened by the binding posts to the base and projecting into the several sides of the re-



No. 479,802.—Brush-Holder.

cess, a rotary spindle, coiled contact springs mounted on split pins carried by the spindle, and the base and cover forming bearings for the spindle.

479,828. Electric Steering Gear; Edgar H. Mumford, Detroit, Mich. Application filed Aug. 20, 1891. In a steering apparatus, the combination of a rudder, rudder-post, tiller arm, a circular arm of magnetic material attached at its middle point to the tiller arm and extending in either direction therefrom into a curved solenoid, a line in electric connection with an electric generator, and a switch adapted to switch the circuit into either or both of the solenoids or to break connection with either or both.

479,834. Device for Indicating Washouts in Railroad Beds; José Ortega Y. Espinosa, Mexico. Application filed Oct. 23, 1891. A chamber with an inclined inlet pipe imbedded in and opening through the side of the railroad embankment, in combination with a float arranged in the bottom of the chamber and containing a movable circuit breaker and one or more electric circuits adapted to be broken by the change in the position of the float.

479,835. Storage Battery Plate; Harry G. Osburn, Chicago, Ill. Application filed Nov. 21, 1891. In a secondary battery electrode, a grid or plate having a multiplicity of connected ribs or bars which are deflected in opposite directions and form open receptacles for active material.

479,849. Thermostat; Thomas W. Shepherd, Peabody, Mass. Application filed Aug. 6, 1891. In a thermostat, a pivoted contact arm and a coiled lamina to move it, combined with a sector the pivotal point of which coincides or is in line with the pivotal centre of the contact arm, and contacts carried by the sector, and a pivoted indicating arm actuated by the sector.

479,859. Telegraph-Key; Albert F. Tucker, Auburndale Mass. Application filed March 24, 1892. In a telegraph instrument, the combination of plates respectively connected with the contact wires, and a key insulated from the plate of the switch, normally in contact with the said plate.

479,886. Electric-Current Regulator; Alvaro S. Krotz, Defiance, O. Application filed March 26, 1891. In a current regulator, the combination, with a generator, of a pivoted lever connected with a commutator-brush holder, means connected with the lever for varying the output of the generator, means comprising a solenoid composed of a series of coils, a core for the solenoid, connected with the pivoted lever, electro-magnetic devices included in the main line and contacts therefor, the contacts being included in circuit with the solenoid.

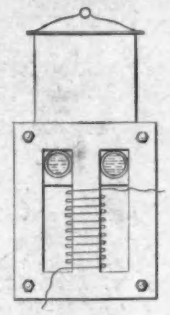
479,887. Galvanic Battery; Felix de la Lande, Paris, France. Application filed June 27, 1891. In a galvanic battery, an electrode and a support therefor, consisting of a frame having shoulders at the top and bottom to sustain the electrode, and a removable spring extending between the shoulders. (See illustration.)

479,928. Electrical Signaling Apparatus; Adoniram J. Wilson, Port Chester, N. Y. Application filed Nov. 9, 1891. In a permissive block signal system applied to overlapping blocks, a signaling circuit operating or controlling the operation of a signal guarding a given section of track, consisting of one block and an overlap on the next succeeding block, in combination with a series of double sets of branch circuits and a series of double sets of multiple circuit instruments controlling the branch circuits, all arranged to be operated in succession in one direction by trains entering the overlap and leaving the overlap in succession, and to be operated in reverse succession and direction by the trains on their subsequently, and one after another, entering the overlap of the next succeeding block, and on their leaving the same.

479,932. Electric Meter; Lucien Victor Brillié, Paris, France. Application filed Oct. 2, 1891. An electric meter consisting of the combination of an electro-dynamometer, an electromotor, a retarder consisting of two relatively movable members, the one connected to the dynamometer to be oscillated thereby and the other connected to the motor to be rotated thereby, and a current regulator for controlling the motor operated by the dynamometer

479,941. Influence Generator of Electricity; William Henry, Detroit, Mich. Application filed May 21, 1891. In an electric generator, the combination of two groups of insulated metallic sectors, one statically electrified to form positive and negative inductors, and the others adapted to move in inductive relation thereto, the sectors of the two groups being arranged in relatively different inductive proximity to each other, whereby polarization takes place in the induced sectors at different moments of time.

479,948. Reciprocating Electric Drill; Frank F. Loomis, Akron, O. Application filed April 11, 1891. In an electric reciprocating drill of the class designated, the combination, with two duplex-wound solenoids arranged in alignment, one wire of each connected with the direct and return circuit of a dynamo and the



No. 479,814.—Electrical Water Heater.

second wires of each connected with branches from the direct and return currents of a circuit-breaker interposed in the branch direct current, and arranged to alternately connect the second wires therewith.

479,949. Electric Switch; Frank F. Loomis, Akron, O. Application filed July 31, 1891. In a revolving electric switch, a tank and a non-conducting cylinder partially covered with conducting material, combined with oppositely disposed brushes arranged to alternately engage the conducting material, and a brush arranged to be in constant connection with the conducting material, and an acid-metallic solution in the tank.

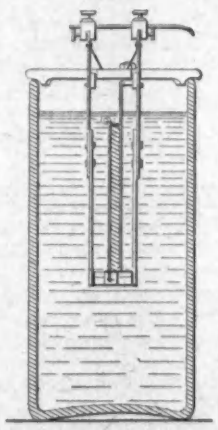
479,950. Fire Alarm Telegraph Indicator; Frank Fowler Loomis, Akron, O. Application filed Dec. 1, 1891. The combination, with escapement actuating magnets arranged to be successively placed in circuit, and vibrating blades, and contact plates arranged to successively place them in circuit, and guide screws of a rocking bar arranged to simultaneously raise the vibrating blades from the guide screws.

479,951. Pulsating Current Generator; Harry N. Marvin, Schenectady, N. Y. Application filed Dec. 3, 1891. The combination, with the commutator of a continuous current armature, of two rotary brushes, contact terminals in electrical connection with the two rotary brushes, respectively, and collecting brushes adapted for connection with the conductors of drill circuits and taking the currents from the terminals alternately.

479,960. Controlling Mechanism for Reciprocating Electric Engines; Charles J. Van Depoele, Lynn, Mass. Application filed Dec. 31, 1889. The combination, with a reciprocating electric engine comprising a magnetic piston and motor coils, of a dynamo electric machine and circuit extending therefrom for supplying currents to the coils in alternation and means for regulating and controlling the rate of rotation of the armature of the dynamo electric machine.

479,962. Reciprocating Electric Engine; Charles J. Van Depoele Lynn, Mass. Application filed Sept. 19, 1890. A reciprocating electric engine system comprising a plurality of motor coils, and a magnetic plunger adapted to be reciprocated therethrough, a source of continuous current, means for dividing the current into currents of continuous direction and of alternating polarity, separate circuits, each including parts of the motor coils, and means for directing the current of one character to one of the circuits and the current of different character to the other circuit, whereby current of one character is supplied to one part of the motor coils and current of the other character to the remaining motor coils.

479,963. System of Supplying Currents to Reciprocating Electric Engines; Charles J. Van Depoele, Lynn, Mass. Application filed April 11, 1891. A system of generating and distributing electric currents, comprising an armature having a suitable winding terminating in two terminals, each of which is connected both to a continuous ring and to a ring forming part of



No. 479,887.—Galvanic Battery.

a circle, a reciprocating electric engine having motor-coils energized by currents of different character, connections between the continuous ring and part of the motor coils, and connections between the remainder of the motor coils, whereby currents of different character are supplied to the separate sets of motor coils.

479,964. System of Distributing Electric Currents; Charles J. Van Depoele, Lynn, Mass. Application filed May 20, 1891. A system of electrical distribution comprising a source of current of the continuous type, means for changing the continuous current into currents of different character, comprising stationary and moving commutator brushes upon the commutator thereof, circuit conductors extending from the brushes, and alternating current, continuous current and combined current translating devices in circuit with the conductors.

479,966. Electrical Transmission of Power; Charles J. Van Depoele, Lynn, Mass. Application filed May 6, 1891. A system of electrical distribution comprising a motor armature, a generator armature, both of the continuous current type, and each provided with a sectional commutator, a common field magnet, a source of supply of relatively high potential connected with the motor armature, stationary and moving brushes on the secondary commutator, and working circuits of different character connected, respectively, with the stationary and with the moving brushes and supplied with current of different character and of modified potential.

480,004. Electric Railway; Charles H. Baker, Lake Geneva, Wis. Application filed Sept. 1, 1891. In an electric railway, the combination, with the motor car, of the conduit rings provided with supplemental arches located on opposite sides of the slot, perforated cylindrical brackets secured over the arches, vertically sliding hangers supported within the brackets and provided with upper flanged heads, and supporting the main conducting wires at their lower ends within the conduit, vertically adjustable contact rollers supported within the conduit from the car frame, means for adjusting the rollers, and wires passing from the rollers to the motor.

480,009. Safety Cut-Out; Rudolph Furgang, Boston, Mass. Application filed Oct. 14, 1891. In a safety attachment for electrical wires, a plate of conductive material provided with spaces or openings, end pieces, swinging weights held normally up, ground connections, a bolt, a spring within a cylinder and a block to which the end of wire is secured.

480,011. Insulator; John Jay Green, Boonton, N. J. Application filed March 24, 1892. An insulator frictionally movable on a central axis having a transverse diametrical groove formed in its upper portion for the introduction of the wire, and channels at right angles to the groove for permanently retaining the wire, which channel is provided with three or more bearing points or surfaces so disposed with reference to each other as to produce a bend in the wire when the insulator has been rotated into position.

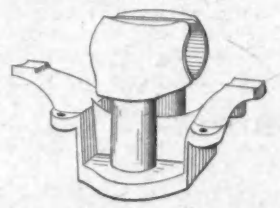
480,038. Testing Apparatus for Electric-Lighting Circuits; Charles H. Rudd, Evanston, Ill. Application filed Dec. 10, 1888. The combination, with an electric circuit containing translating devices and an electric generator, of a rheostat adapted to be connected with different sides of the generator and a ground branch including a condenser, a galvanometer, and a discharging device, the ground branch being adapted to be connected between different coils of the rheostat, whereby the location of any accidental leak on the lamp-circuit may be approximately located.

480,039. Device for Measuring Electrical Currents; Charles H. Rudd, Evanston, Ill. Application filed Nov. 6, 1891. The combination, with a field coil, in circuit of the currents to be measured, of a measuring coil concentric with and in the field of the field coil and movable with respect thereto, and means for interrupting the current through the field coil, and a telephone included in the circuit.

480,049. Field Magnet Frame for Dynamo-Electric Machines; Ernest P. Warner, Chicago, Ill. Application filed Feb. 10, 1890. The combination, in the field magnet frame or casting for a dynamo-electric machine, of the feet raised above the heel-bar thereof, the heel-bar, the movable frame of the carriage on which the feet are placed, and arms curved outwardly and extending above the feet, and the bearings of the armature supported on the arms. (See illustration.)

480,050. Duplex Arc Lamp; Ernest P. Warner, Chicago, Ill. Application filed Feb. 24, 1891. The combination, with two pairs of carbons placed in derived circuit, of a unitary electromagnetic device for controllin g the same and a polarized electromagnetic switching device or commutator adapted on the reversal of the current to transfer the arc from one pair of carbons to the other.

480,070. Train Order Annunciator; Leonard T. Crabtree, Embarrass, Wis. Application filed Oct. 11, 1891. In a train order annunciator, the combination, with a battery, a switchboard,



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main line wires, a receiving instrument, a train order recorder and indicator, and wires connecting these devices electrically, of an electrically connected signal bell, a normally open circuit closer and a mechanical device connecting the circuit closer with a rock shaft and treadle arm thereon that will be depressed by the impinging of wheels on a locomotive or car, close the circuit and ring the bell.

480,099. Electric Jail Plate; William S. Hull, Sheffield, Ala. Application filed Dec. 8, 1891. An electrical plate for the walls of jails, safes, vaults, etc., consisting of two outer plates, an intermediate insulated plate and bolt or rivets binding the plates together, the holes in the intermediate plate being larger than those of the outer plates.

480,100. Electric Screen for Doors or Windows; William S. Hull, Sheffield, Ala. Application filed Feb. 3, 1892. A guard or screen composed of two sections arranged face to face and normally separated and slidingly supported with interposed springs, and a sounding device and battery electrically connected with the section.

480,147. Automatic Device for Electric Block Signals; Joseph B. Stewart, Haverstraw, N. Y. Application filed Jan. 26, 1892. In an electric railway signal, an automatic device for locking and unlocking the signal levers, comprising a closed electric circuit having opposed batteries and including a magnet at each end, the local circuits controlled by each local circuit, and a track, the rails of which are divided in divisions, the rails of each division being connected to the main circuits by taps.

480,151. Rheostat; Charles W. Tobey, New Bedford, Mass. Application filed July 11, 1891. A resistance conductor for electric currents, consisting of a composition of proportionate parts of powdered graphite, asbestos and cement, compressed into a cohering, compact body.

480,152. Electric Cord Tip; Charles W. Tobey, New Bedford, Mass. Application filed Nov. 24, 1891. A device for use in connection with electric conductors, consisting of a strip bent into U form and having both of its legs forked or provided with open-ended slots to admit the shank of the fastening screw.

480,240. Trolley for Electric Cars; Geo. E. Purple and Charles W. Purple, Minneapolis, Minn. Application filed Sept. 8, 1891. The combination, with a trolley wheel and its supportin yoke, of arms pivotally supported on the axis of the wheel, yielding device or devices connecting the arms with the yoke, and spring-controlled dogs carried by the arm.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.